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Top—Emulsified oil waste, Eldorado, Kans., field.

Bottom—Emulsified oil waste, Cushing field, 1915.

•

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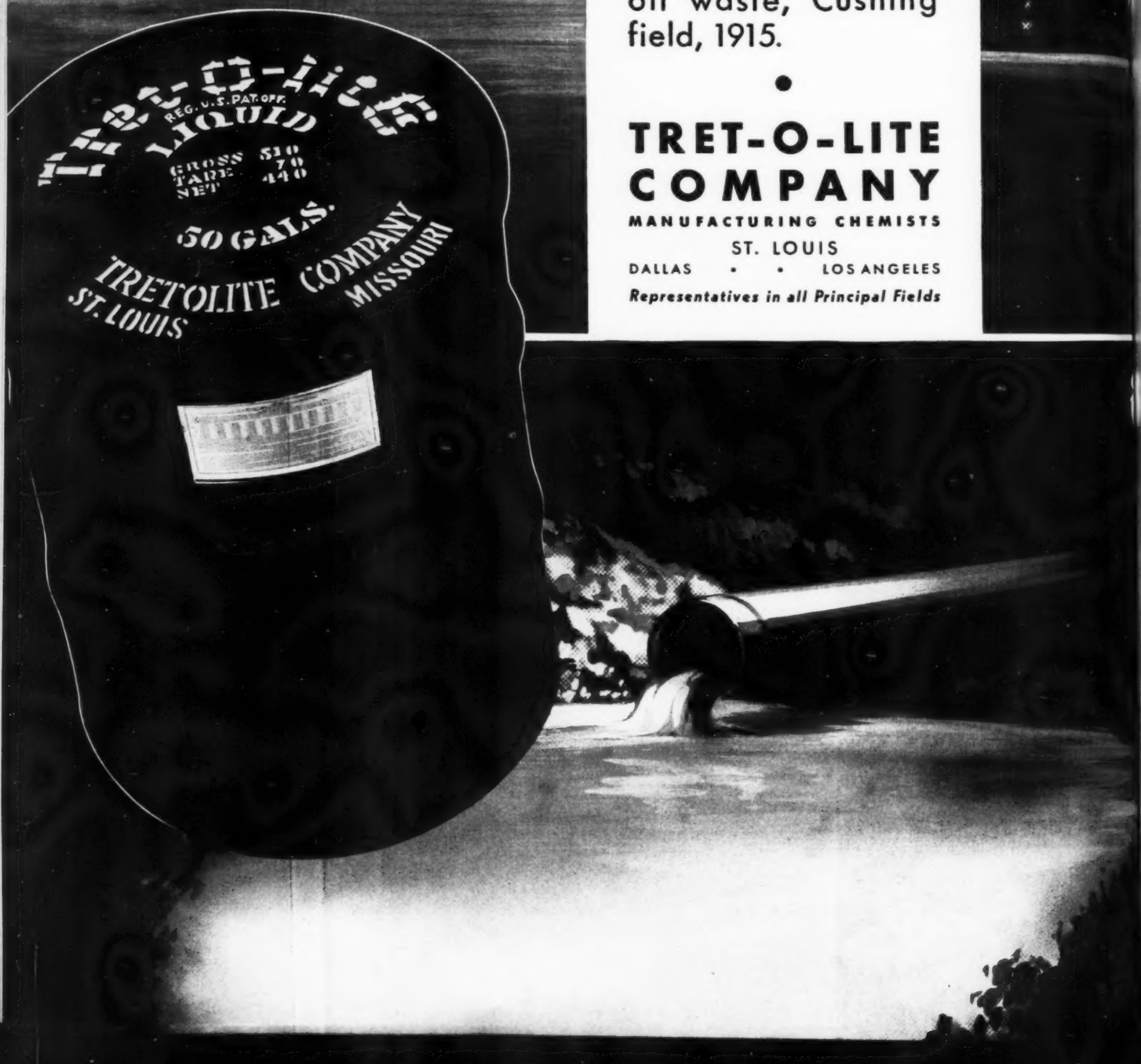

THE Petroleum Engineer

MARCH 1937

VOLUME VIII NUMBER 6

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

American Association of Petroleum Geologists, 22nd. Annual Convention—March 17, 18, and 19, Biltmore Hotel, Los Angeles.

California Natural Gasoline Association—April 1, Richfield Building, Los Angeles, California.

American Petroleum Institute, Division of Production, Southwestern District, Spring Meeting—April 1 and 2, Baker Hotel, Dallas, Texas.

Petroleum Industry Electrical Association—April 8, 9, and 10, Shreveport, Louisiana.

American Petroleum Institute, Division of Production, Pacific Coast District—April 13, Biltmore Hotel, Los Angeles, California.

Western Petroleum Refiners Association, 25th Annual Meeting—April 26, 27, and 28, Arlington Hotel, Hot Springs, Arkansas.

American Petroleum Institute, Division of Production, Eastern District—May 6 and 7, Deshler-Wallick Hotel, Columbus, Ohio.

American Gas Association, Natural Gas Department—Week of May 10th, Kansas City, Missouri.

Natural Gasoline Association of America, Annual Convention—May 19, 20, and 21, Hotel Tulsa, Tulsa, Oklahoma.

American Petroleum Institute, Mid-Year Meeting—June 1, 2, and 3, Broadmoor Hotel, Colorado Springs, Colorado.

Oil-World Exposition, Inc.—October 11, 12, 13, 14, 15, and 16, Houston, Texas.

International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20, and 21, 1938, Tulsa, Oklahoma.

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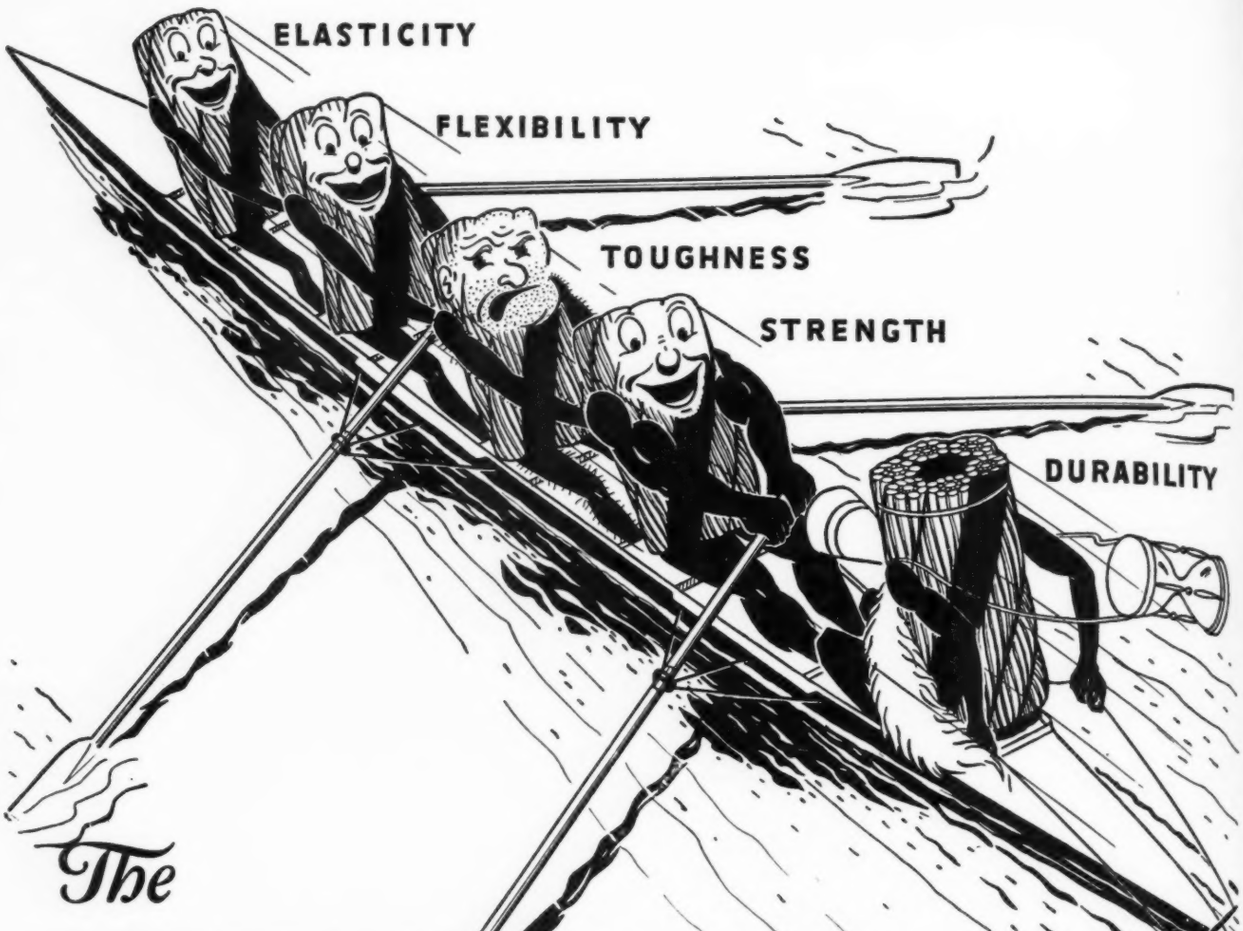

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The Course of Oil

By K. C. SCLATER

First Lucas Medallist

A signal honor came last month to J. Edgar Pew, vice-president of the Sun Oil Company, when he received the Anthony F. Lucas Medal for distinguished achievement in the field of petroleum. Mr. Pew is the first recipient of the award.

His indefatigable efforts in standardization work in the petroleum industry are known far and wide and need no comment here. He can look back over the years and take pride in his accomplishment.

His is a task well done and the honor that has come to him is a highly merited one.

Drilling to Maintain Allowables

Again a warning of the evils of the practice of drilling unnecessary wells has been voiced. This time by Joseph E. Pogue, well-known petroleum economist, in a paper read before the spring meeting of the Mid-Continent District of the A.P.I. Division of Production at Tulsa last month. In commenting on the fact that proration now is so conducted that a premium is placed upon the drilling of unnecessary wells, he said that the practice has been stimulated by the employment of aggregate potentials, rather than potentials per unit of area, and that this unsound practice is authorized because it presents an opportunistic advantage to many individuals concerned only with small leases.

He points out that the consequences of this procedure, besides raising costs and engaging redundant capital, are to create a condition that requires only an excess of discovery or else a downward trend in consumption to disrupt equilibrium and so precipitate a reversal in the oil cycle. This, he goes on to say, "is potentially a threatening element in the situation, one calling for remedy. Its dangers are hidden by a (at present) rapidly mounting demand and a tendency toward a subnormal discovery rate; but a favorable factor of safety in the situation is thereby eradicated.

"It is desirable that the application of proration shall make it unnecessary to drill wells except to produce oil; now thousands of wells are drilled each year merely to maintain allowables—a function that could be fulfilled by the labor of a few clerks. Can the industry afford to countenance practices that cannot withstand logical analysis and would do it discredit if investigated: especially if such practices are apt to be a contributing factor to the next depression in the oil business in the event of sustained discovery?"

In sounding this note of warning Mr. Pogue points to the very root of the evil when he says that thousands of wells are drilled merely to maintain allowables. Drilling of excess wells in proven fields is the direct result of unsound proration methods. Remove this undesirable factor and a potential threat of instability on the prosperous horizon of the industry will be dispelled.

Two Major Objectives

What practical substitute can be devised for the Rule of Capture, which generally is credited with being the major cause of instability in the industry? For several years this has been a subject of study by a committee of the A.I.M.E., and last month at the annual meeting of the society in New York, one of the major topics of discussion was bearing on this question. In a paper by Earl Oliver, chairman of the committee mentioned, on whether the Rule of Capture could be rationalized it was brought out that "Efficient extraction of oil and gas at the time and rate society needs them, together with equitable allocation of these products and the markets for them among their respective owners, are the two major objectives of the petroleum industry. Stability within the industry is dependent upon accomplishing both of these objectives. However, simultaneous accomplishment of both objectives under the Capture Rule is impossible. It is, therefore, mechanically impracticable. It promotes high cost, waste, and inefficient recovery to a degree that compels the granting of subsidy through tariff protection to keep the industry solvent.

"On the other hand, Ownership in Place is the direct antithesis of the Capture Rule in every respect mentioned. It tends to build up while the Capture Rule tends to tear down. It has for its orderly administration every process of ownership devised through the centuries. In its application two methods of allocating the product among owners are available, namely, the mechanical separation method in non-unitized pools and the engineering appraisal method in unitized pools. Neither method would be mathematically accurate, but both can be made to do substantial justice among owners and come within standards set by the law. Both are incomparably better than the Capture Rule to attain that end.

"The Capture Rule and Ownership in Place represent two distinct concepts of ownership. One breeds government regulation. The other breeds industrial self-control.

"The Capture Rule breeds destructive competition, and destructive competition leads either to industrial monopoly or to government control. Since industrial monopoly would not be tolerated in the present state of public opinion, the inevitable result must be government control, if that rule is perpetuated. The oil industry is now in the process of passing out of the stage of destructive competition into that of government control, a thing we need to avoid equally as we do industrial monopoly. The oil industry can avoid both."

To consider means to that end is the function of this committee. It is a question that vitally affects the entire industry.

« « HIGHLIGHTS IN OILDOM » »

Venezuela Oil Production to New High

Despite sharp curtailment in December, resulting from labor difficulties, petroleum production in Venezuela reached its peak in 1936. Aggregate production for 1936 was 22,945,299 metric tons, an increase of four percent over the previous year. The highest monthly production was in September with 2,093,646 metric tons.

Export trade of Venezuela also established a record for that country during 1936. Foreign shipments totaled 22,874,072 metric tons, an increase over 1935 of 11 percent.

●

Texas House Favors 6-Cent Crude Tax

The Texas House of Representatives recently passed a bill increasing the tax on crude oil from 2¾ cents to 6 cents a barrel. The measure is now before the Senate. One-half the income from the tax, or an estimated $15,000,000 annually, would be used for old-age pensions, one-fourth would go into the school fund, and one-fourth to the general fund under provisions of the bill.

●

High Court Approves Sweet Gas Law

The United States Supreme Court has upheld provisions of the Texas law, passed in 1935, prohibiting the burning of sweet gas for the manufacture of carbon black. The Henderson Company, operators of a natural gasoline plant at Sanford, Texas, instigated the test case.

The Supreme Court gave an unanimous decision in affirming a ruling by a three-judge Federal District Court in Texas that denied an injunction against enforcing provisions of the law. The Henderson Company contended that the legislation, intended to stop the waste of natural gas resources, would result in the loss of a carbon black contract and would be "tantamount to the taking of property without due process." In giving its decision the high court said that the statute was not shown to have been an arbitrary exercise of legislative power.

Replying to the contention that the statute impaired the obligation of contracts, the court said the law "deals merely with the use of an article of commerce and its effect upon contracts is incidental."

●

Mexican Govt. Enters the Oil Business

A new general administration of national petroleum was created by President Lazaro Cardenas of Mexico immediately upon the expiration March 1st of the semi-official Petroles de Mexico. The newly-created agency is to take over and operate the old company's assets as well as any future oil concessions the government may grant the body. This places the Mexican government in the oil business in competition with private interests.

The presidential decree gives sweeping powers to the new government organization, including authority for the acquisition, production, leasing, transportation, storage, refining, and distribution of petroleum, gas, and their by-products.

Independent producers, however, seem little disturbed by the decree. Some have expressed the fear that, inasmuch as the government agency will be tax free and employees will be government employees, it may have an unequal competitive advantage. For the most part, however, private interests do not see anything in the decree that indicates private leases are endangered immediately. As a matter of fact, there is reason for belief that the government agency may cooperate with private industry, based on a clause stating a purpose of the action is to "secure development of the petroleum industry." Furthermore, the agency's general manager is authorized with the president's approval to execute "contracts for exploitation of reserve lands" held by the government. This is viewed as meaning that possibly the agency presently may lease unused lands to private concerns on a royalty basis.

●

Curbing Gas Waste in Rodessa Field

According to a report made by the engineering committee of the Rodessa Operators' Committee, the gas-oil ratio on the Louisiana side of the field is now 1662 cu. ft. of gas per bbl. of oil, indicating that the serious problem of a year ago is being solved satisfactorily.

In making its report the committee lists producing wells on the Louisiana side as follows: 279 oil wells, 54 gas wells producing and 33 shut in, a total of 366 wells. The report states that gas produced with the oil now totals 83,112,000 cu. ft. daily, an average of 297,000 cu. ft. a well. The gas-oil ratio of 1662 to 1 is based on the field allowable in Louisiana of 50,000 bbl. daily. Effective January, 1937, all distillate wells on the Louisiana side of the field were classified as gas wells and each oil well was given an individual allowable.

Further interesting data revealed in the report were that of the 83,112,000 cu. ft. of gas being produced with the oil 37,490,000 cu. ft., or 45 percent, is being put into lines along with the yield from gas wells. The volume of gas now going into lines is estimated at 46,000,000 cu. ft. daily, and the volume discharged to atmosphere is somewhat less than that figure.

●

Crude Production in Steady Advance

For the fifth consecutive week crude oil production established a new peak, daily average production on March 6 being 3,298,800 bbl., according to the American Petroleum Institute. This advance is considered of little consequence, however, inasmuch as demand is approximately 25 percent greater than a year ago and the greatest in history.

●

Pennsylvania Crude Prices Advance

Reflecting the generally more favorable conditions in the petroleum industry Pennsylvania crude on February 24 advanced ten cents a barrel. Quotations now are: Bradford, $2.67 a bbl.; Southwest Pennsylvania, $2.42; Eureka, $2.37; Buckeye, $2.22; and Corning grade, $1.32. The latter was the only grade that did not show an advance.

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Progress of Major Pipe Line Work

THE Cabot Gas Corporation of Olean, New York, and its affiliate, Godfrey L. Cabot, Inc., have completed a 118-mile pipe line system for the transmission of natural gas from fields of northern Pennsylvania and southern New York to Rochester and Geneseo, New York, to serve industrial interests. The Cabot Gas Corporation laid 94 miles of 14-in. line, and Godfrey L. Cabot, Inc., the producing affiliate of the Cabot Gas Corporation, laid 24 miles of 12-in. from the state line to the Sabinsville field. The line was electrically welded.

The I. C. Little Construction Company of Dallas, Texas, was the contractor on the 14-in. job, and Gannett, Eastman and Fleming, of Harrisburg, Pennsylvania, constructed the 12-in. line.

During the summer a compressor station will be erected in Genesee Township, Potter County, Pennsylvania. In the meantime well pressure is sufficient to boost the gas through the line.

●

Between Thrall and Kansas City, Kansas, the Standish Pipe Line Company is reconditioning a portion of its system to provide for a full 8-in. line. Additional pumping equipment also is being installed and when completed the capacity of this section will be increased to 20,000 bbl. daily. Increased demand for crude by the Kansas City, Kansas, refinery of the Phillips Petroleum Company, of which the Standish Pipe Line Company is an affiliated organization, has made this enlargement program necessary.

●

The Cities Service Gas Company is to construct 47 miles of 12-in. pipe line from the south end of the company's 16-in. Seminole, Oklahoma, line to the gasoline plant of the Carter Oil Company 12 miles south and six miles east of Ada, Oklahoma. Increased demand for gas in the Kansas City area has made an additional supply necessary and Cities Service has contracted with Carter for 6,000,000,000 cu. ft. per year.

Pipe for laying the new line will be taken up from portions of the company's system no longer in use and reconditioned. The construction of the line will be in charge of Harry McDaniel, and it will be oxy-acetylene welded by the Lindeweld method.

The gas will be transported to Kansas City via Drumright, Tallant, and Grabham compressor stations.

●

H. C. Price, Inc., Bartlesville, Oklahoma, has announced completion of the electric welding of 32 miles of 8-in. pipe line for the Gulf Refining Company, Pipe Line Division, near Carthage, Texas. The Latex Construction Company of Houston, Texas, was the general contractors.

H. C. Price also announces a contract received from J. F. Pritchard and Company of Kansas City for electric welding 59 miles of 8-in. line in Kansas for the Phillips Petroleum Company.

●

The Latex Construction Company of Houston, Texas, is laying 14 miles of 10-in. line for the Gulf Refining Company, Pipe Line Division, from Fairfield, Texas, to a point just north of Oakwood. The work is expected to be completed between March 20 and 25.

●

The White Eagle Division of Socony-Vacuum is to loop its existing pipe line system from Valley Center, Kansas, to a point northwest of the Hollow Pool in Harvey County, a distance of 43 miles. The loop will be of 10-in. pipe. Two 250-hp. gasoline engines and certain electrical equipment also will be added to the system, increasing its capacity to 60,000 bbl. daily.

●

The Skelly Pipe Line Company has completed the laying of an 11-mile lateral from its main line in the Lorraine pool of Ellsworth County, Kansas, to the Bloomer pool of Barton County. The line connects with six producers owned by the Skelly Oil Company on its 80-acre lease, having a potential of 15,947 bbl. daily. Oil also will be taken from other wells in the field. The total number of wells in the pool is 30, with a potential of 60,000 bbl. daily.

●

The Simrall Pipe Line Company plans to lay a 6-in. line from its Buckeye, Michigan, pumping station to Mount Pleasant, a distance of 30 miles, according to a recent announcement. Crude will be delivered to the Roosevelt Oil Company and to the Michigan-Toledo Pipe Line Company, the latter transporting it to Toledo refineries.

The Pure Transportation Company is laying 11 miles of 6-in. line from the Buckeye field to Beaverton.

These two projects have resulted from the rapid growth of the new Buckeye Township pool. Already there are six producing wells in the field and approximately 40 rigs are drilling.

●

The Oklahoma Pipe Line Company is reconditioning 34 miles of 8-in. line east of Hugo, Oklahoma. Williams Brothers, Inc., Tulsa, Oklahoma, have the contract for the work.

●

The Southern Liberty Pipe Line Company, subsidiary of the American Liberty Oil Company, is to lay a crude gathering system in the Texas side of the Rodessa field. It will purchase oil and handle production of the American Liberty, the crude to be delivered to the Texas Pipe Line Company for transportation to the Gulf Coast.

●

According to reports the Gulf Refining Company, Pipe Line Division, will construct an oil line from the new Lisbon field of Claiborne Parish, Louisiana, to tie in with its Arkansas-Dubberly line.

●

The Barnsdall Refining Corporation will lay a 70-mile 6-in. pipe line from the Placedo field of South Texas to Corpus Christi, where a 5000-bbl. capacity refinery is being constructed. Further details of the line's construction have not been announced.

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Latest Activities In The Oil Fields

SUMNER County, Kansas, was given a new pool when No. 1 Rogers of the Patton Drilling Company, west of the Wellington pool, was drilled to a depth of 2050 ft., the hole filling with oil. At latest reports it had not been determined whether the producing formation is the Topeka or Howard lime.

●

A wildcat strike in Nueces County, Texas, that operators think may be the opening of a field equal to any in the area, has been made by I. J. Allen and the Seaboard Oil Corporation. Their No. 2 J. O. Chapman, 8500 ft. southwest of the London field discovery well, has the earmarks of a large producer from the Frio sand at a total depth of 6500 feet. On a ten-minute drill stem test it had 1100 ft. of 42-gravity oil.

●

No. 1-F State of the Humble Oil and Refining Company, Monument Pool, Lea County, New Mexico, set something of a record recently when it was completed and flowing 31 bbl. of oil an hour from a total depth of 3860 ft. in 17 days from the date the test was spudded in.

●

Pure Oil Company's discovery in Clay County, Illinois, is being looked upon as the possible rebirth of the oil industry in the state. That company's No. 1 Weiler recently was completed for a natural flow of from 75 to 100 bbl. daily. The well is four miles south of Clay City and was drilled to a total depth of 2250 ft., which is deep for the locality, as most of the wells produce from 750 to 1000 feet. Nearest production to the new strike is 40 miles distant.

●

Barnsdall Oil Company's No. 1 Rancho San Francisco, in the Newhall-Pico area of Los Angeles County, is the center of considerable interest and has resulted in rather active leasing in the immediate vicinity. It has been drilled to a total depth of 6276 ft. and on production tests made approximately 100 bbl. of 58-gravity distillate and 5,000,000 cu. ft. of gas. The hole is to be deepened.

Apparently a discovery of outstanding importance is that of the Shell Petroleum Corporation at Bayou Cocotriz, Terrebonne Parish, Louisiana. That company's No. 1-B Realty Operators was brought in flowing 38.1-gravity oil at a temperature of 98 deg. fahrenheit. The well was drilled to a total depth of 9493 ft. and is producing from the lower Miocene formation. The well, which opens a new field, made 781 bbl. on the initial test, flowing through a 16/64-in. choke for a period of four hours, and through 14/64-in. choke for 20 hours.

●

What may prove to be the deepest producing well in Texas and the second largest commercial producing well in the world is in process of completion by Harrison and Abercrombie in the Old Ocean field, Brazoria County. The company's No. 3 Bernard River Land and Development Company drilled to a depth of 10,293 ft., producing an estimated 13 bbl. of 52-gravity oil an hour through ¼-in. choke.

●

A five-mile southwest extension has been given the Rodessa field by the Arkansas-Louisiana Gas Company's No. 1 W. S. Ford. The well is on the Texas side of the field in Marion County. Its total depth is 6351 ft., and casing was gun-perforated at 5995-6110 feet. After jetting with gas on March 8 the well flowed at a rate of 25 to 30 bbl. an hour.

●

Empire Oil and Refining Company's No. 1 Jordan, approximately 12 miles southwest of St. John, Kansas, has been successfully completed after being plugged back to a depth of 3840 feet, opening a new pool. On the initial test it made 585 bbl. daily by natural flow, and after being acidized produced 127 in an hour through a half-opened master gate valve.

AVERAGE CRUDE PRICES

California	
Kettleman Hills	$1.22-1.43
Playa Del Rey	1.10
Coalinga	.70-.90
Signal Hill	1.10
Montana	1.35
Wyoming	.97-1.30
Colorado	1,12-1.18
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.27
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .93-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.40
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.42
Pennsylvania	
Bradford	2.67
Southwest	2.42
Eureka	2.37
Buckeye	2.22
Corning	1.32
West Virginia	1.67
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (February)	Week Ended F b. 27, 1937	Week Jan. 30, 1937	Week Ended Feb. 29, 1936
Oklahoma	581,900	603,000	587,750	499,500
Kansas	170,000	183,200	173,600	149,650
Panhandle Texas		75,900	74,800	60,450
North Texas		66,950	65,600	56,600
West Central Texas		31,900	32,700	24,800
West Texas		190,300	171,200	162,200
East Central Texas		107,700	105,950	48,600
East Texas		452,050	449,350	436,600
Southwest Texas		218,100	187,550	122,700
Coastal Texas		194,450	180,950	168,200
TOTAL TEXAS	1,203,400	1,337,350	1,268,100	1,080,150
North Louisiana		69,700	86,350	66,200
Coastal Louisiana		173,400	165,150	133,750
TOTAL LOUISIANA	225,100	243,100	251,500	199,950
Arkansas	28,500	27,500	23,050	29,550
Eastern	114,300	117,550	116,000	107,950
Michigan	29,400	33,100	29,000	37,300
Wyoming	41,900	52,250	48,800	32,150
Montana	14,700	15,550	16,450	12,400
Colorado	4,500	4,450	3,550	4,000
New Mexico	81,600	97,350	92,850	57,100
TOTAL EAST OF CALIF.	2,495,300	2,714,400	2,610,650	2,209,700
California	573,300	581,700	583,400	565,000
TOTAL U. S.	3,068,600	3,296,100	3,194,050	2,774,700

3 THRIFTY DIESELS ON THE JOB IN TEXAS

"Caterpillar" Diesel Engines are available in five sizes—from 44 hp. to 180 hp.

ON THIS drilling operation near Sullivan, Texas, Don Danvers uses a 125-hp. "Caterpillar" Diesel Engine to pull a Sheldon-Burdon draw-works. Another—of 100 hp.—operates a Gardner-Denver mud pump; and a third—of 60 hp.—drives an electric generator for all the lighting.

Mr. Danvers reports that these Diesels have cut his power fuel costs to *80c a day*—a mere fraction of the fuel-and-water costs of a steam outfit doing the same work.

Never before has engineering made greater progress toward cheaper power than is represented in these cost-cutting "Caterpillar" Diesel Engines. Even with up-keep, depreciation and investment charges included, their total operating cost is still far below that of other types of power. It will pay you to find out about this new form of power . . . there's a dealer near you—with factory-trained service men and stocks of machines and parts.

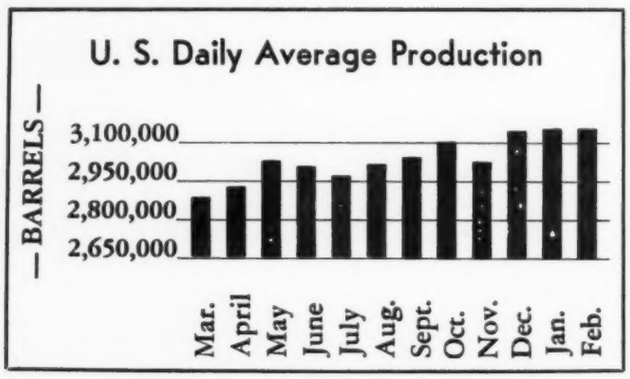
CATERPILLAR DIESEL ENGINES

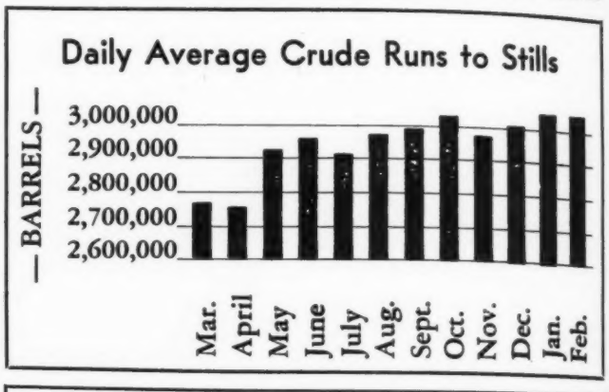
REG. U. S. PAT. OFF.

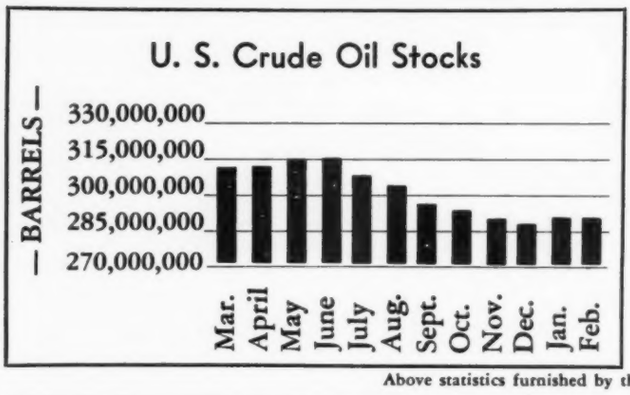
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

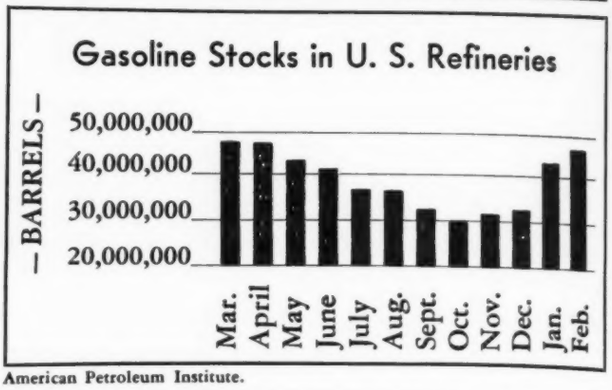
WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES

Summary of Petroleum Statistics and Field Activities









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for February, 1937

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	140	138	39	46	3500-3700	2	40	Rotary
Duval County	73	61	22	51	1554-2900	2	22	Rotary
Archer County	26	9	2	12	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	44	44	18	98	1700-3900	2	40	Rotary
Refugio	9	9	2	11	4900-5900	2	38	Rotary
Nueces County	53	49	17	54	3922-5878	2 or 3	21-54	Rotary
San Patricio County	12	10	2	9	3987-6141	2	23-65	Rotary
Talco Field	29	29	11	40	4230-4361	2	16-24	Rotary
Oklahoma								
Oklahoma City	10	8	4	24	6450-6682	3	39	Rotary
Fitts Pool	49	46	6	68	1800-4488	2 or 3	38	Rotary
Osage County	6	6	3	15	380-2850	2	37.5-40	Rot.-Cab.
Kansas								
McPherson County	5	4	2	9	2900-4300	2	38	Rot.-Cab.
Russell County	28	24	8	52	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	27	23	15	60	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	12	8	6	31	3300-4375	2 and 5	42-48	Rot.-Cab.
Louisiana-Texas								
Rodessa	29	29	15	57	5950-6450	3	39	Rotary
New Mexico								
Lea County	40	36	13	95	3150-4030	.....	.....	Rotary
California								
Kettleman Hills	2	2	2	14	8300-8730	3 or 4	40	Rotary
Midway-Sunset	8	8	15	25	1400-3100	1 and 2	11-30	Rot.-Cab.
Mountain View	2	1	6	8	5200-6000	2	20-40	Rotary

Field Activities by States for February, 1937

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1936 (In Barrels)
	February	January	February	January	February	January	February	January	February	January	
Arkansas	11	....	3	....	12	....	8	6	26	24	10,461,000
California	94	82	59	67	96	166	75	74	229	228	214,883,000
Colorado	2	1	2	0	....	....	2	2	23	22	1,670,000
Illinois	1	....	1	....	....	....	28	29	9	8	4,452,000
Indiana	6	16	4	7	....	....	5	6	25	24	795,000
Kansas	139	110	108	84	164	114	50	47	363	342	58,226,000
Kentucky	5	35	4	20	....	....	15	18	45	44	5,653,000
Louisiana	61	38	38	27	56	84	29	30	201	207	79,980,000
Michigan	53	57	35	29	63	74	77	74	146	140	11,852,000
Mississippi	....	....	....	....	....	....	3	2	9	8	Gas Prod.
Montana	4	10	4	9	....	....	4	2	43	44	5,632,000
New Mexico	47	48	42	43	....	....	17	15	120	119	27,134,000
New York	....	....	....	....	....	....	8	2	22	8	4,637,000
Ohio	63	172	43	135	....	....	71	83	251	264	3,834,000
Oklahoma	192	174	142	128	190	153	58	59	449	451	206,082,000
Pennsylvania	....	....	....	....	....	....	29	34	144	139	15,830,000
Texas	942	947	777	716	1037	1352	442	551	1503	1696	391,097,000
West Virginia	64	68	55	53	....	....	30	31	172	171	3,903,000
Wyoming	5	7	5	7	....	....	3	4	42	46	13,650,000
Total	1689	1772	1322	1330	1630	1943	954	1069	3822	3985	993,942,000

Beaumont, Texas, in the days of the Spindletop discovery in 1901 where high, wide and handsome deals flourished. Some were fabulously profitable — many were disastrous. These brokers included all sorts of individuals from clerks, business men and true oil men to dubious speculators. Withal, curbstone brokerage has always added a romantic spark through all the history of oil's progress.

High excitement, such as marked the colorful days of the curbstone brokers, has not been lost to oil production. . . . Success is always exciting. For example, from the 9,000 wells treated with Dowell *Inhibited* Acid, additional oil valued at over $50,000,000 has been recovered for operators. The combined enthusiasm of these producers is louder, by far, than the most stirring sale ever held.

DOWELL JELLY SEAL

Better control of *Inhibited* acid in well treatment results from Dowell's latest advance — Dowell Jelly Seal. So positive are results that wells formerly not responding to ordinary acid treatment now show decidedly profitable results. Dowell Jelly Seal widens the scope of Acidizing. Write for your copy of The Dowell Acidizer just published, entirely devoted to "Jelly Seal in Acidizing." Available at all Dowell offices.

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OIL AND GAS WELL CHEMICAL SERVICE

The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 65.9 Percent **Central Division, 78.2 Percent** **Eastern Division, 85.1 Percent**

THE STANDARD OIL COMPANY of Louisiana will construct a $2,750,000 plant for the manufacture of lubricating oils at its Baton Rouge refinery, it has been announced by M. J. Rathbone, president of the company. Construction will begin in three months.

●

Barnsdall Refining Corporation has announced plans for the construction of a 5000-bbl. capacity refinery on the ship channel at Corpus Christi, Texas. The plant is to run on the company's own crude produced in the Placedo field. A 6-in. pipe line, 70 miles long, to bring the crude from the field to the refinery is a part of the project.

Placedo crude naturally contains practically no gasoline but when cracked yields a motor fuel of exceptionally high octane rating. The crude will be charged direct to the cracking unit and is expected to produce more than 56 percent gasoline of 75 to 76 octane number.

The refinery has its own wharfage on deep water where tankers will be loaded with gasoline to be distributed in the coastwise trade and for export. The low-viscosity cracked fuel oil also will be transported by tanker to shipping centers on the eastern seaboard.

Barnsdall already has signed a license agreement with Universal Oil Products Company for a Dubbs cracking unit and has let a contract for construction to the Frick-Reid Supply Corporation.

●

The Shell Petroleum Corporation and the Sinclair Prairie Oil Company have entered into an agreement to construct a natural gasoline plant in Moore County, Texas. The plant's capacity will be 65,000,000 cu. ft. daily. An agreement also has been made by the two companies with the Columbian Carbon Company for the erection of a carbon black plant to utilize residue gas from the plant. The total expenditure for the two plants is estimated at $1,500,000.

A new casinghead gasoline plant will be constructed in the Cayuga field of Texas by the Cortex Petroleum Corporation, of which Fred M. Allison is head. It will be situated on the Litchfield lease of the Cortex company near the Anderson and Henderson county lines. Equipment already has been moved to the site.

●

T. E. Patton of Mineral Wells, Texas, has announced plans for the erection of a 500-bbl. skimming plant in Garza County, south of Post City, Texas. Crude supply will be from the small field approximately two and a half miles southwest of that town.

●

The Texas Company is adding a new 15,000-bbl. distillation unit to its refinery at Port Arthur, Texas. The unit is a 2-stage atmospheric and vacuum pipe still and was designed by E. B. Badger and Sons Company. The unit is expected to be completed early in July.

●

Mercury Oils, Ltd., Calgary, Canada, is considering the construction of a refinery in the producing area of South Turner Valley. A. H. Mayland heads the company.

●

The Hanlon Gasoline Corporation of Texas has completed the revamping of its present absorption plant into a gas-liquefying plant for the extraction and production of 95 percent of butanes and a corresponding amount of propanes. The Parade Gasoline Company also has remodelled its low-pressure absorption plant for the production of 95 percent of butanes. Both plants also are extracting natural gasoline contained in the gas. The Gregg-Tex Gasoline Co. has revamped its vapor-rectification type plant into a gas-liquefying plant for the production of both gasoline and liquid butanes and propane. All these plants are in the East Texas field.

Crude Runs to Stills, Gasoline, and Gas and Fuel Oil Stocks
Week Ended February 27, 1937
A.P.I. Figures

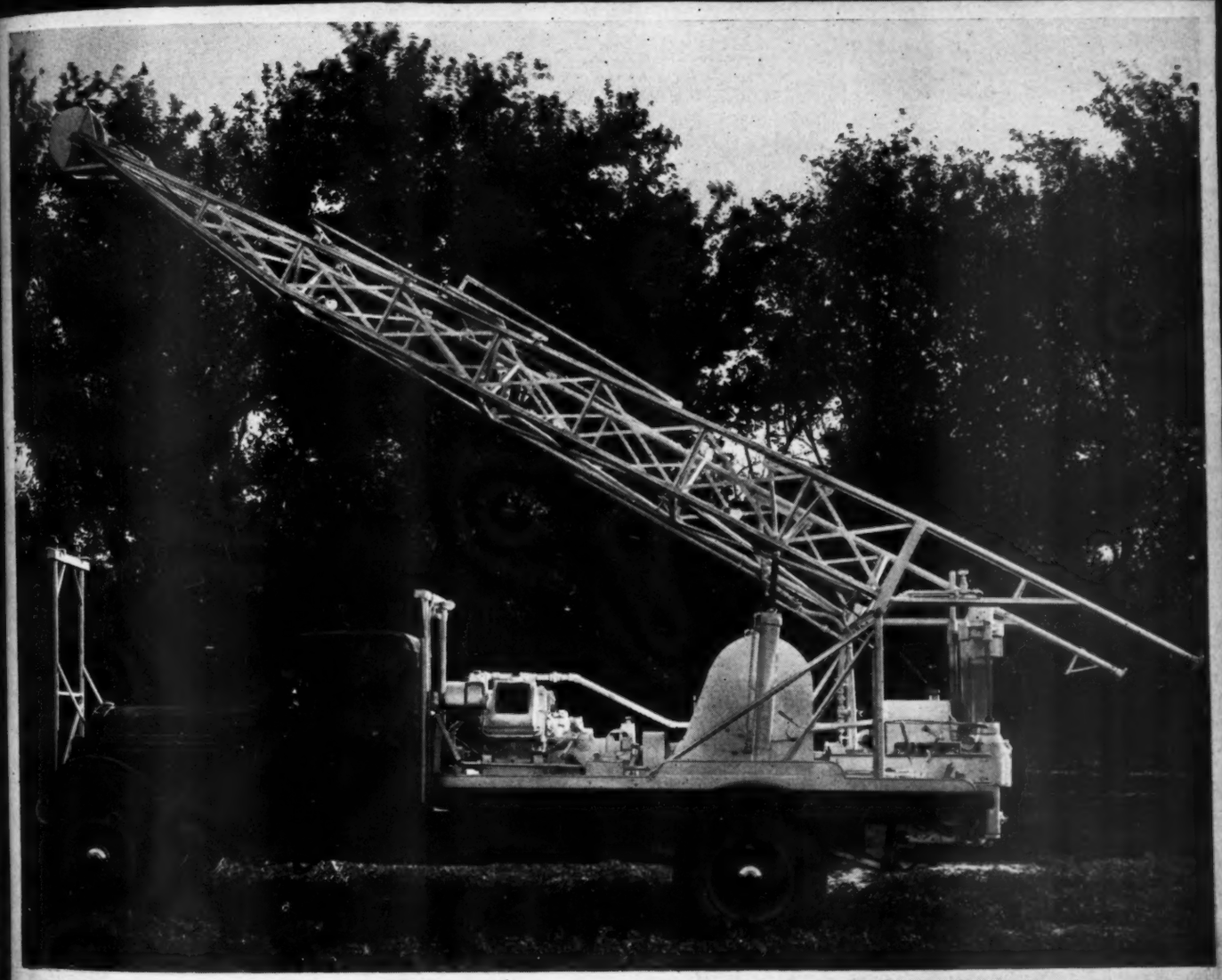
(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	521,000	77.9	16,371	7,388
Appalachian	88.4	110,000	85.3	2,599	568
Ind., Ill., Ky.	92.1	430,000	92.1	12,975	4,803
Okla., Kans., Mo.	84.6	310,000	81.6	9,291	2,819
Inland Texas	54.3	121,000	66.1	2,164	1,306
Texas Gulf	95.5	663,000	87.6	10,432	6,369
La. Gulf	96.3	137,000	86.7	1,680	1,655
No. La.-Ark.	63.7	40,000	69.0	455	274
Rocky Mt.	69.7	42,000	67.7	1,808	696
California	90.9	478,000	64.1	14,844	70,528
Reported	88.8	2,852,000	79.0	72,619	96,406
Est'd Unreported	.....	233,000	.....	3,997	2,770
*EST'D TOTAL U. S. Feb. 27, '37	.....	3,085,000	.....	76,616	99,176
*EST'D TOTAL U. S. Feb. 20, '37	.....	3,065,000	.....	74,798	99,391
U. S. B. of M. *Feb. 27, '36	.....	**2,811,000	.....	71,297	97,134

*Estimated Bureau of Mines basis.
**February, 1936, daily average.

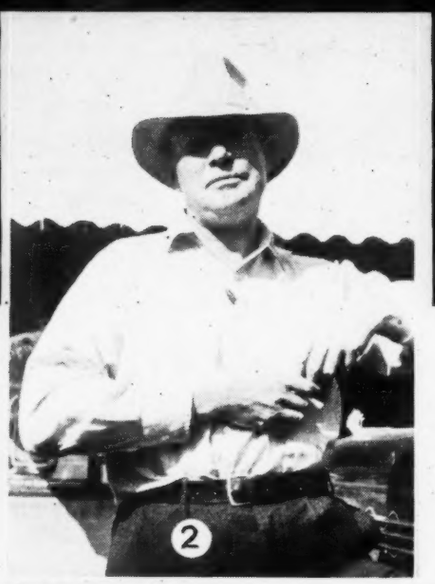
PICTORIAL PETROLEUM

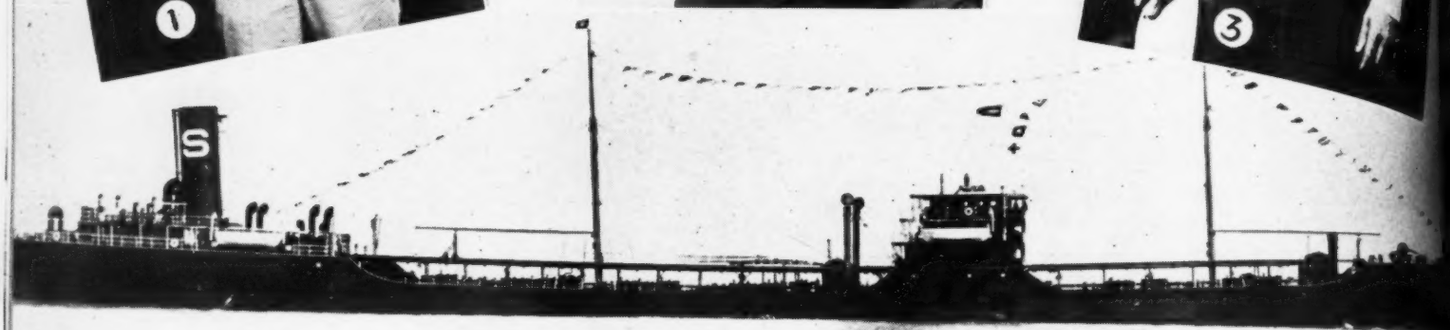
A REGULAR FEATURE OF THE PETROLEUM ENGINEER



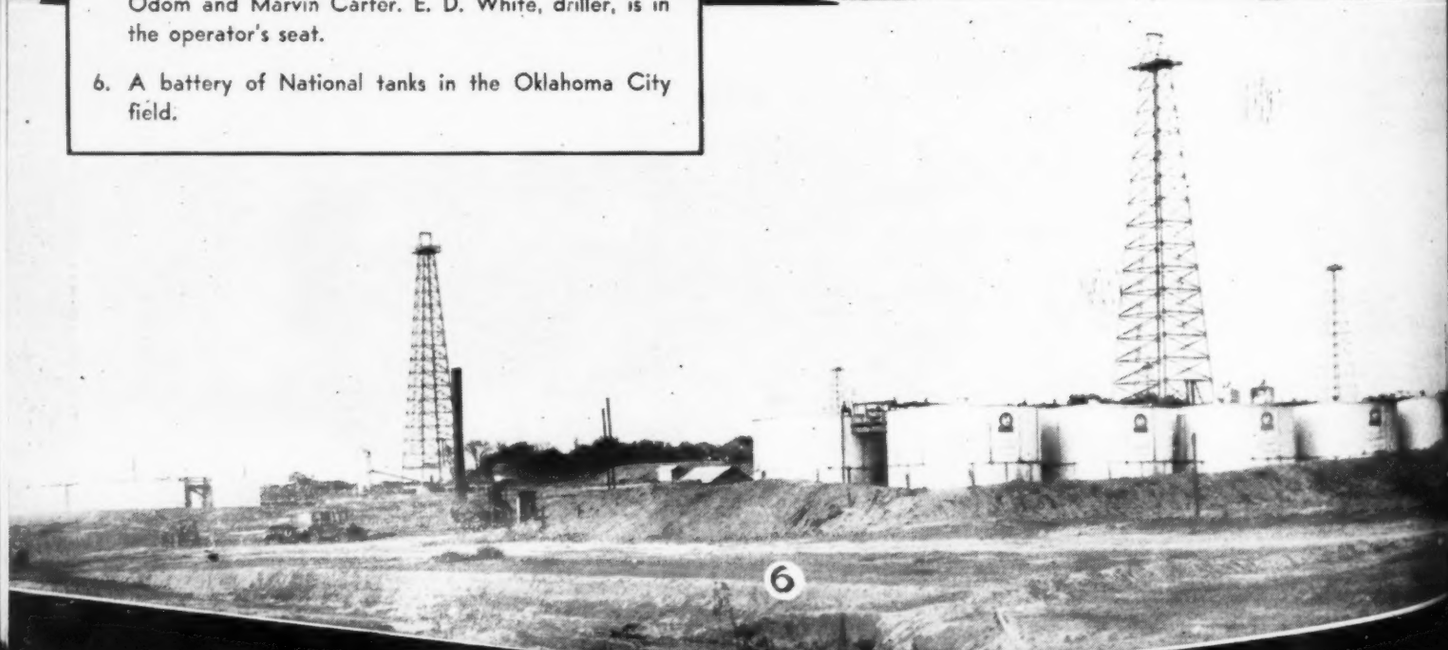
CAPABLE OF DRILLING TO 2500 FEET

This rig manufactured by George E. Failing Supply Co., is an excellent example of the very latest in modern prospecting drilling machines. Successfully incorporated in its design is the difficult combination of extreme portability and high drilling efficiency.





1. Cliff Reese, sales manager, Globe Oil Tools Co., Los Nietos, Calif.
2. Jess Crosby, independent operator, Cowley, Wyo.
3. V. M. Kirk, independent operator, Frannie, Wyo.
4. The new Socony-Vacuum oil tanker "Mobilgas," launched recently at Chester, Pa., where it was constructed by the Sun Shipbuilding and Dry Dock Company. It is more than 500 feet long and has a tank capacity of 5,510,000 gallons.
5. Crew unspooling Macwhyte power cable for a new well on Gant Garvin & Wegener operations near Turnertown, Texas. Left to right: Clifford Branch, Hubert Odom and Marvin Carter. E. D. White, driller, is in the operator's seat.
6. A battery of National tanks in the Oklahoma City field.



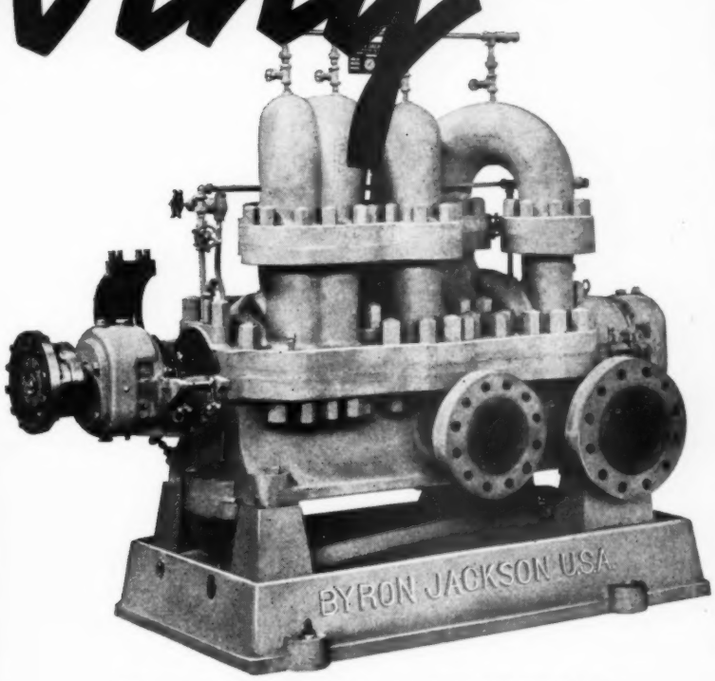
Oil— FROM CALIOLA TO MARTINEZ!

Five Byron Jackson 4 by 6, 6-stage O. L. Multiplex Pumps are installed on the Shell Pipe Line, the sixth being the same type, but 4-stage. All are steam turbine driven.

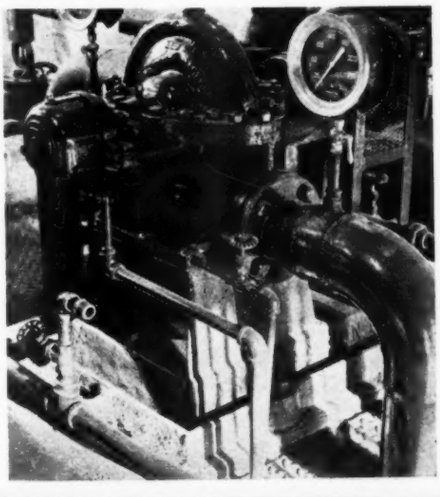
BYRON JACKSON PUMPS ARE *Moving* IT!

In each of the six stations on the new **SHELL PIPE LINE**, from Caliola to Martinez, California—a distance of almost 258 miles—you will find a **BYRON JACKSON** Oil Line Multiplex PUMP delivering up to 560 gallons of oil per minute, at 765 lbs. maximum discharge pressure.

These pumps were specified by Shell Oil Company Engineers because of their proved efficiencies, their long life, and their marked economy of operation. We are proud of the part they play in the successful operation of this modern pipe line.



Widely used by the Oil Industry, Byron Jackson "O. L." (Oil Line) Multiplex Pumps are of extremely rugged construction. Note also the long external cross-overs which provide good hydraulic lines between stages, thus increasing efficiencies.



Byron Jackson Type S Pumps, also steam turbine driven, deliver 350 gallons per minute of water for fire protection, at 150 lbs. discharge pressure.

•

To complete your files, send for specifications on these, and other, successful Byron Jackson Centrifugal Pumps.

BYRON JACKSON COMPANY

Established 1872

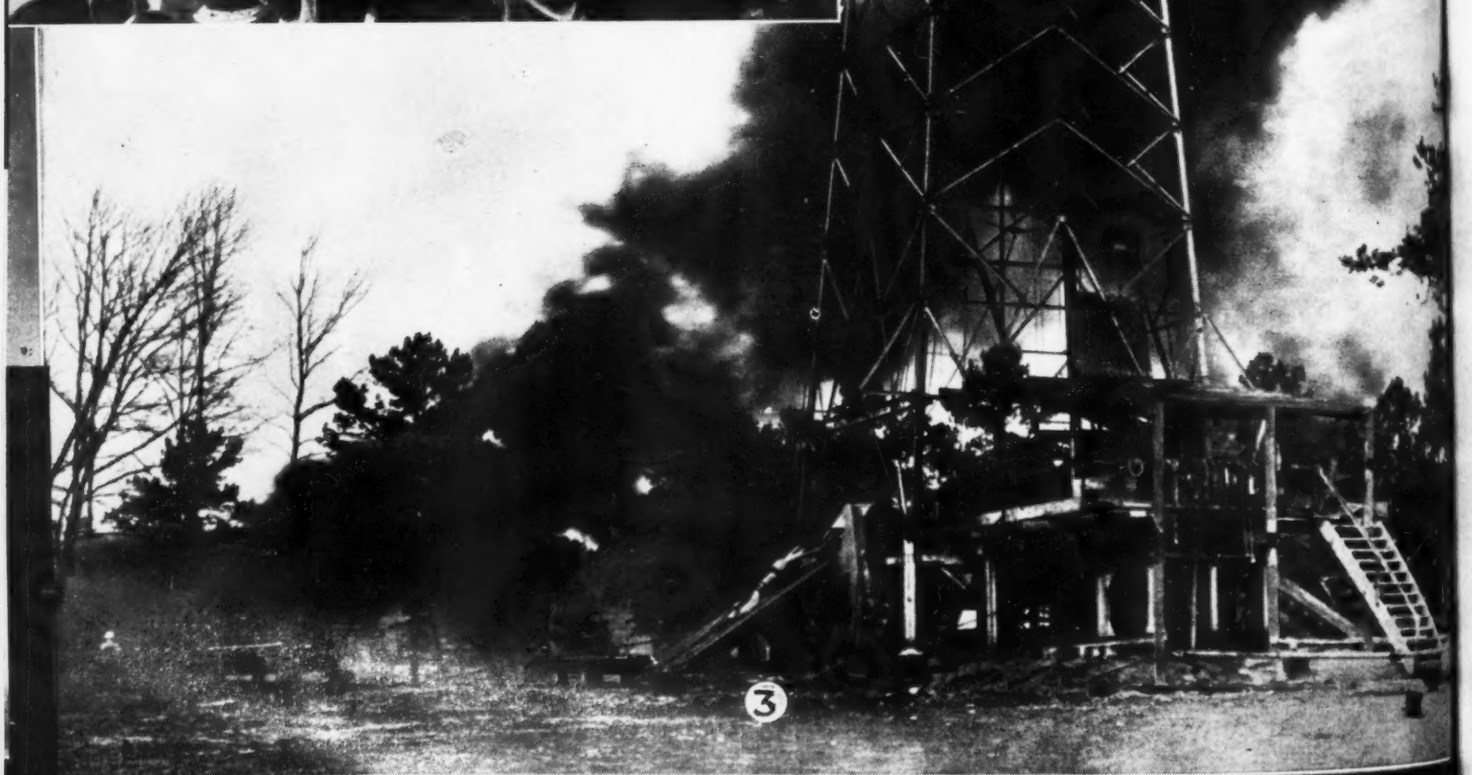
Berkeley LOS ANGELES Bethlehem

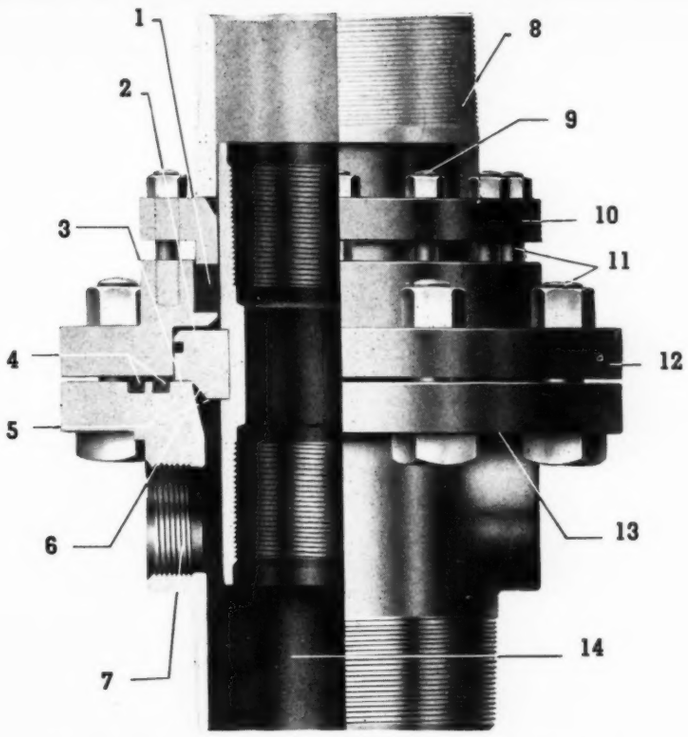
BYRON JACKSON CENTRIFUGAL PUMPS

1. Lizzie Henderson, "upwards of 90," owner of the land on which the Jefferson discovery well is located.

2. Drilling crew of the Jefferson discovery well. Left to right: Dan Crowe, Otto Deutsch, Hugh Castle, H. B. Horbon and Driller Pete Pyland.

3. Flesh & Hootkins, Holcomb & Thomasson, Henderson No. 1 well which geologists say will open a large new field near the town of Jefferson, Texas. When the picture was taken the well, according to Pete Pyland, driller, was making 30 barrels through a half-inch choke every seven minutes.





1. 1½" x ¾" collar packing—oil and acid resisting rubber of low sulphur content to insure against sticking.
2. Vertical loading on split rings—no possibility of distorting casing.
3. Ground joint seat provides metal to metal shut-off, enabling auxiliary packing to be replaced without killing pressure between strings.
4. Special hydraulic packing seals off behind the ground joint seat.
5. Only ⅜" loss of tension when picking up pipe preparatory to landing.
6. Bevel on split ring centers casing readily when landing.
7. 3" side outlets, faced and countersunk on all heads, provide ample circulation space between strings.
8. Adapter gland for use where an outside thread is desired, as (a) in case of wild well, and (b) routine drilling-in operations.
9. Recessed coupling, same O.D. as casing collar and same I.D. as heavy pipe, threaded for A.P.I. Grade "D" long collar casing.
10. Standard gland packs off around collar.
11. Heat treated special alloy bolts and studs provide extra strength.
12. Hold down flange locks pipe in well and compresses hydraulic packing.
13. Machined shoulder eliminates need of back-up wrenches when tightening bolts.
14. Full opening bottom flange eliminates reduction in area and prevents sand cutting.

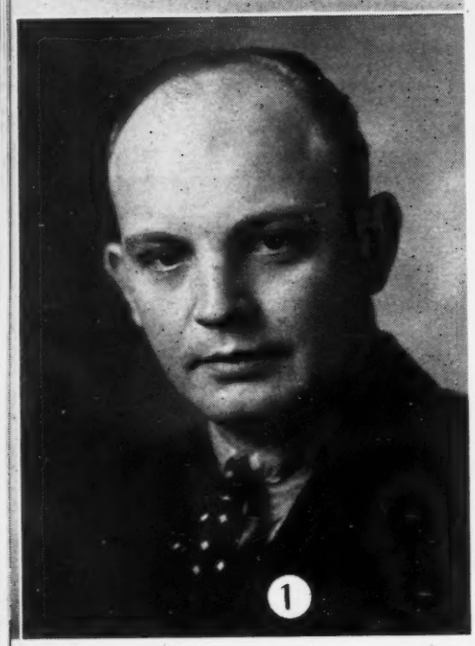
And the above advantages are not all: The RECTORHEAD is the only casing head fully repackable under high pressure. . . . It requires less than 15 inches of cellar space . . . the split rings rest on a flat surface, not a tapered bowl, and thus your seating element is safe from the destructive whipping of the Kelly while drilling through.

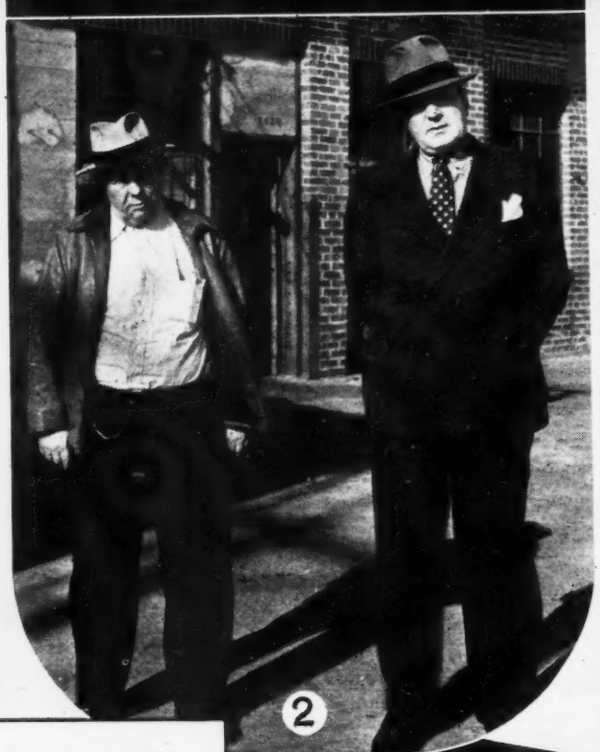
Buy It from Your Supply Store

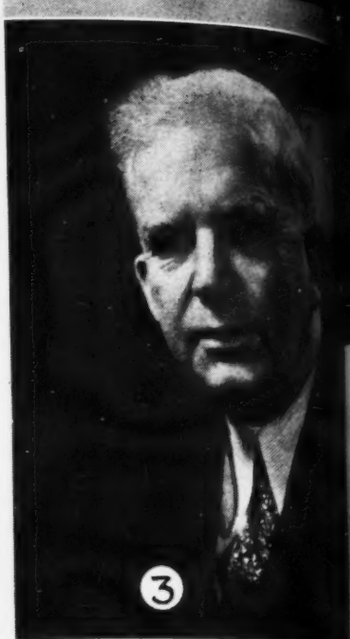
RECTOR WELL EQUIPMENT CO. INC.

FORT WORTH, TEXAS

WICHITA FALLS MIDLAND TULSA SHREVEPORT HOUSTON







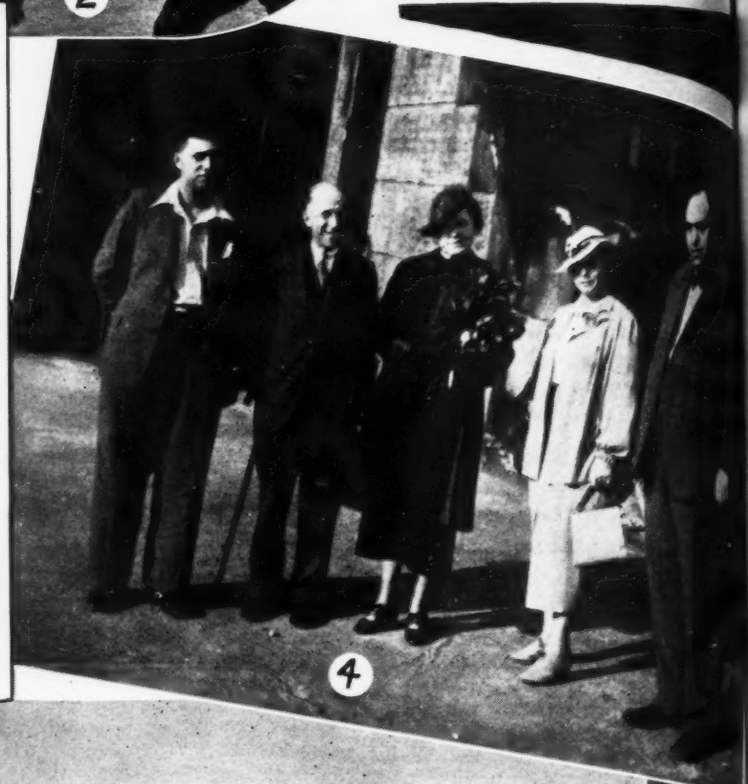
1. J. M. Kenderdine, sales engineer, Norvell-Wilder Supply Company, Houston, Texas.

2. H. H. Frank (left), president, and Carl White, Jr., vice-president, of Franks Manufacturing Corp., Tulsa, Oklahoma. The firm was recently expanded by purchase of the former Tidal Oil Company warehouse and machine shops in Tulsa where they will manufacture additional truck motor-driven and skid type winches, portable hydraulic drilling units, spudding machines, portable telescopic masts and power take-offs.

3. J. U. Stair, vice president in charge of production, Shell Oil Company, Los Angeles.

4. Taken at the railroad station in Lwow, Poland, the photograph shows (left to right): Emil Hajdu; Geo. B. Morris, president, Bradford Motor Works, Bradford, Pa.; Mrs. Morris, Mrs. Hajdu and Marcin A. Hajdu, importer of oil well supplies for use in Polish fields.

5. Anglo-Persian oil well as seen from the ruins of Masjid-i-Sulaiman, ancient Zoroastrian fire temple. Surface structure of the field, apparently so plain and easy to see in this picture, was highly confusing to geologists during early life of the field. Photo courtesy Clarence Lockwood.



Fit any Situation

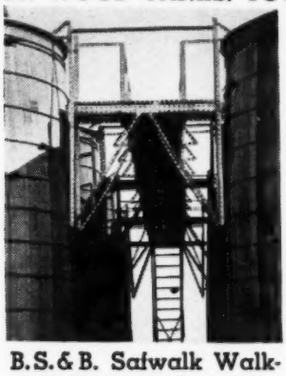
AS EASY TO ERECT AS CHILDRENS' TOYS

Modern Walkways, Stairways and Loading Racks

B.S.&B. LOADING RACKS

Ten-car loading rack in Texas. Swinging platforms with safety catches give easy access to domes of tank cars. Greater convenience—greater safety.

FOR WOOD TANKS, TOO



B.S.&B. Safwalk Walkway between two rows of H500 bbl. B.S.&B. Durable Wood Tanks.

TRUE BRIDGE-TRUSS DESIGN

TYPICAL B.S.&B. "SAFWALK" INSTALLATION

Stairway in center—saves time and steps. Note walkway hung from deck chimes on brackets. No posts in switcher's way.

RUNWAYS and CATWALKS in Refineries and Gasoline Plants.

TOOL ROOM SHELVING

STORAGE BINS

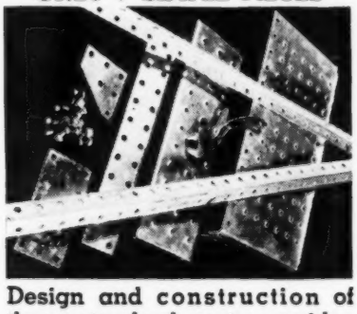
LADDERS

FIRE ESCAPES

B.S.&B. HAND RAIL DESIGN

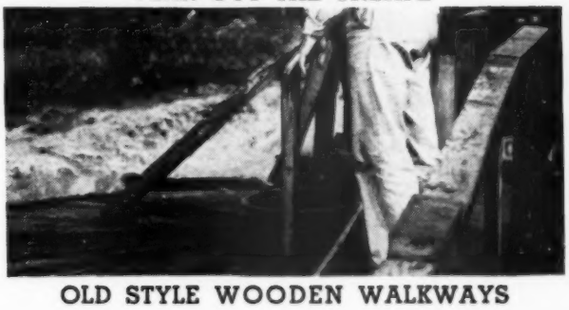
This trussing, used on all B.S.&B. Walkways, makes for stiffer, steadier construction.

ONLY 7 SIMPLE PIECES



Design and construction of these standard parts provides versatility and flexibility for unlimited practical application.

TEAR OUT THE UNSAFE



OLD STYLE WOODEN WALKWAYS Short lived—Unsafe—Impractical. PUT UP THE SAFE B.S.&B. WALKWAYS.

INSURE SAFETY TO WORKMEN — ECONOMY TO OPERATORS

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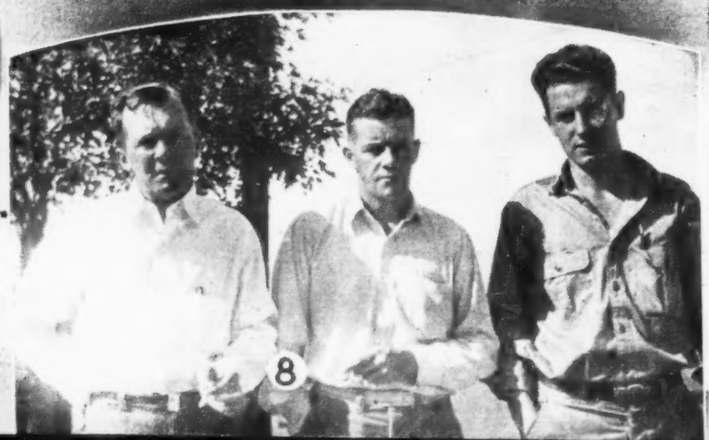
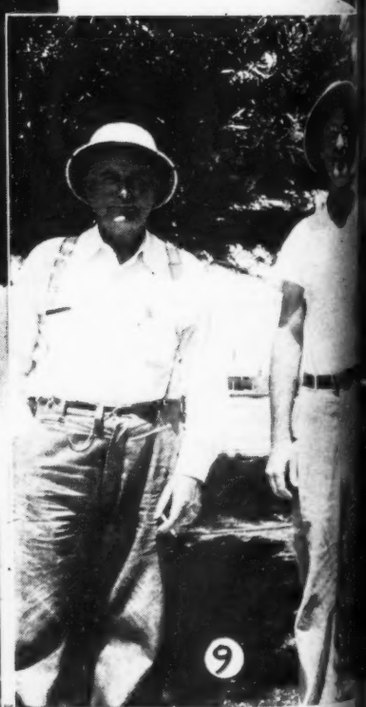
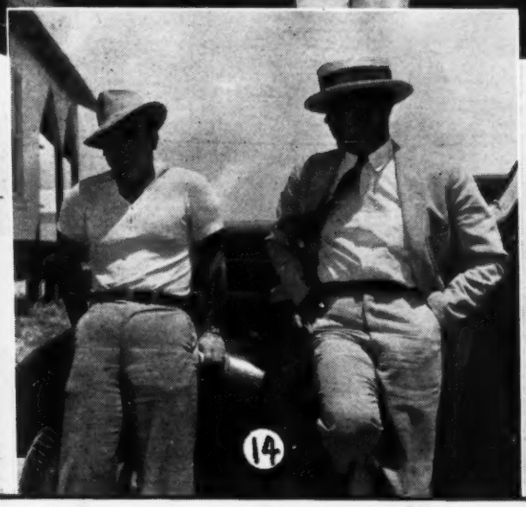
OKLAHOMA CITY

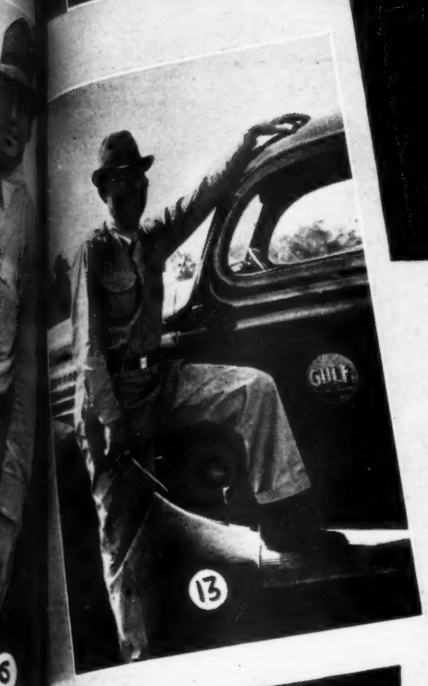
Operating and Supply Men in Mid-Continent and Western Fields

1. W. H. Emerson, resident engineer, Sperry-Sun Well Surveying Co., Long Beach, Calif.
2. M. J. (Heavy) Lewis, owner M. J. Lewis Oil Well Service, Long Beach, Calif., and Houston, Texas.
3. Jerry L. Evans, district manager, National Supply Company, Long Beach, Calif.
4. A. V. Turner, representative for Jensen Bros. Mfg. Co., at Casper, Wyoming.
5. W. H. Gleason (left), production foreman, Richfield Oil Co., Ventura, Calif., and J. R. Dabney, district manager of The Cavins Company.
6. John M. Sweeny, assistant to the superintendent, Sun Oil Co., Odessa, Texas.
7. W. A. Andrews, drilling superintendent for Bell & Loffland at Avenal, Calif.
8. Left to right: F. A. Hertmeyer, petroleum engineer, Standard of California, Kettleman Hills; J. P. Shea, and A. F. Eadie, petroleum engineers.
9. E. A. McCurdy (left), pipe line superintendent, and H. M. Van Clief, toolpusher, both with Honolulu Oil Company, Taft, Calif.









10. Mose Wagner, superintendent, Montana Power & Gas Co., Cut Bank, Montana.
11. Left to right: F. S. Boland, head roustabout, Amerada Petroleum Company, Penwell, Tex.; J. C. Woods, store manager, Frick-Reid Supply Co., Odessa, Texas; and W. M. Alkire, district superintendent for Amerada, at Odessa.
12. Dick Boggs, general superintendent, Richfield Oil Co., Montebello, Calif.
13. Walter Walsh, drilling superintendent, Gulf Production Co. at Crane, Texas.
14. H. McCarty (left), district superintendent, Humble Oil & Refining Co., Big Spring, Tex., and J. W. House, district drilling superintendent for the Humble Oil & Refining Co., at Midland, Tex.
15. R. G. Taylor, representative for the Guiberson Corporation at Bakersfield, Calif.
16. Steve Thomas (left), superintendent of transportation, Rocky Mountain Drilling Co., and W. H. Smith, Casper, Wyo., representative of Reed Roller Bit Co.
17. C. J. Read (left), mud engineer for Rocky Mountain Drilling Co., Casper, Wyo., and R. L. Maxwell, toolpusher at Bridger, Mont., for the same company.
18. Jack Winters, mud engineer, in the Gulf Coast territory for Colox Sales & Service, Houston, Texas.
19. J. O. Brown, district foreman, Shell Petroleum Corp., Big Spring, Texas.

Left: S. Belither, president, Shell Oil Company. Center: J. R. Gignoux, chief field engineer for the Shell. Right: F. B. Simms, superintendent of pipe lines, Shell Oil Company.

4. Making a tie in near Mid with Diesel-powered Caterpillars.
5. Welding operation on the line was by shielded-arc process with Lincoln Electric Company machines and electrodes. H. C. Price, Inc., of Bartlesville, Oklahoma, was the welding contractor.
6. Making a tie in with 12-inch pipe north of Caliola.
7. The Bakersfield pump station.

SCENES on Shell Oil Company's new 258-mile pipe line from Bakersfield to Martinez, California

Described editorially in February issue of The Petroleum Engineer

BEACONS

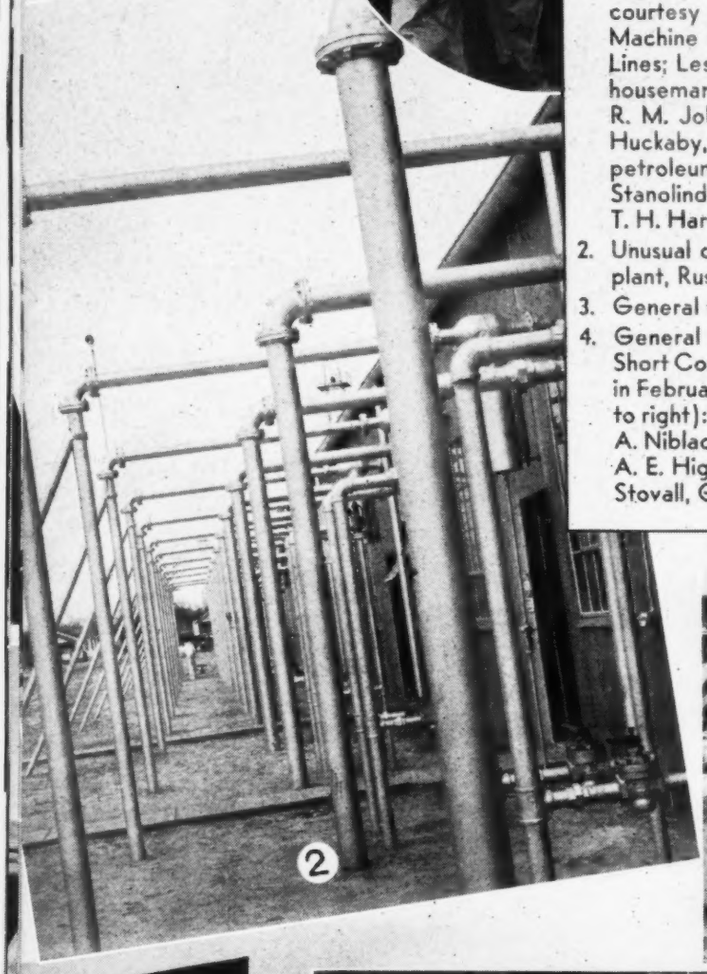
Fig. 1740 Gaso Duplex Piston Timken Bearing Power Pump. 54 to 250 Bbls.

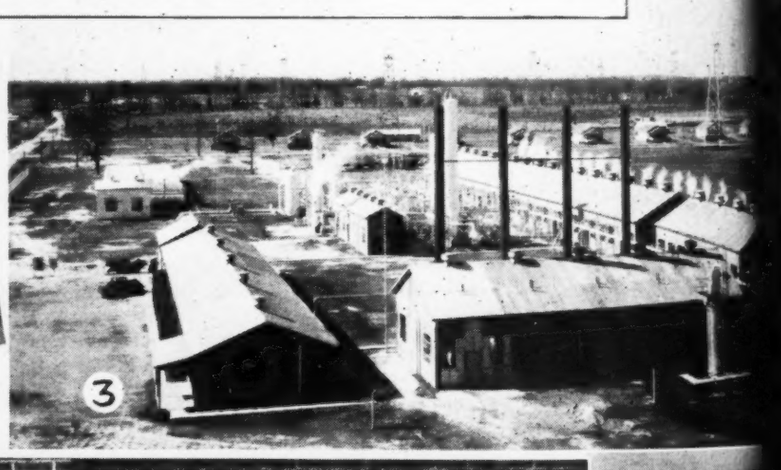
Just as the beacons guide the aviator to his destination, so do the names of certain manufacturers guide the purchaser to honest value. . . . Gaso is proud to belong to this group. . . . To oil men everywhere, the Gaso mark is a dependable guide to *economical* performance, backed by *reliable* service. . . . Gaso Pump & Burner Mfg. Co., Tulsa, Okla. Export Office: 149 Broadway, New York.

Complete Gaso Condensed Catalog, in 1937 Composite Catalog

GASO PUMPS
for every oil industry need

1. A group of South Houston operating men which we reproduce by courtesy of the photographic department of Lufkin Foundry & Machine Co. Back row (left to right): Bill Smith, English Truck Lines; Lester Bilbie, Stanolind Oil & Gas Co.; John Siese, warehouseman, Stanolind; M. C. Kelly, production clerk, Stanolind; R. M. Johnston, head roustabout, Stanolind. Front row: John Huckaby, toolpusher, Noble Drilling Company; J. C. Ragsdale, petroleum engineer, Stanolind; Fred Beteau, superintendent, Stanolind; C. M. Holsted, petroleum engineer, Stanolind. Sitting: T. H. Harder, production foreman, Stanolind.
2. Unusual camera study of the piping at Sinclair's No. 19 gasoline plant, Rusk County, Texas.
3. General view of Sinclair's No. 19 gasoline plant.
4. General Committee of the Southwestern Gas Measurement Short Course which met at the University of Oklahoma at Norman in February to formulate plans for the 1937 school. Standing (left to right): Max Watson, L. G. Rheinberger, Earl Knightlinger, Kate A. Niblack, G. B. Lane, J. H. Satterwhite, G. W. McCullough, and A. E. Higgins. Front row: W. H. Carson, W. R. McLaughlin, E. E. Stovall, Gilbert Estill, and F. C. Walters.





THROUGH O-C-T TYPE "Q" TUBING HEADS

Completing high pressure wells through O-C-T type "Q" Tubing Heads is "standard practice" in most high pressure fields today. Designed for use with blowout preventer equipment for drilling in, running and landing tubing, the inside diameter of this Tubing Head is the same as that of the pipe on which it is used. Retractable hanger seats permit the use of full size bits and packers. Patented lock-down screws force the hanger into sealing position against 6000 pounds pressure and permit the removal of blowout preventer equipment in perfect safety. The tubing hanger passes through the blowout preventer and master gate valve, which have the same inside diameter as the pipe, and lands on the retractable seats, which will safely support 200,000 pounds. Tubing hanger may be lowered any depth below its seating position by simply backing out the retractable seats. After the well has been brought in, the tubing can be raised or lowered against pressure by inserting a plug in the tubing string and re-installing blowout preventer equipment. The accompanying sectional drawings clearly illustrate the advantages of O-C-T type "Q" Tubing Head.

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CABLE ADDRESS OCENTOL

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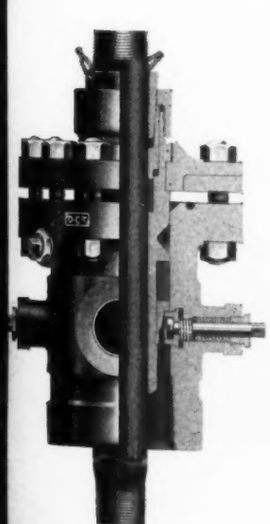
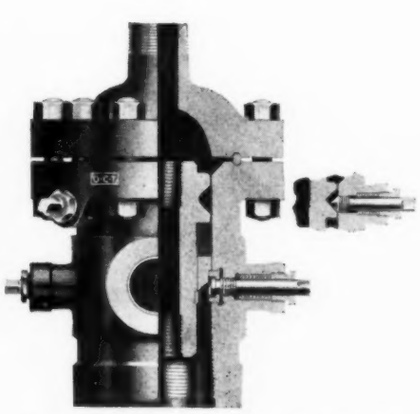
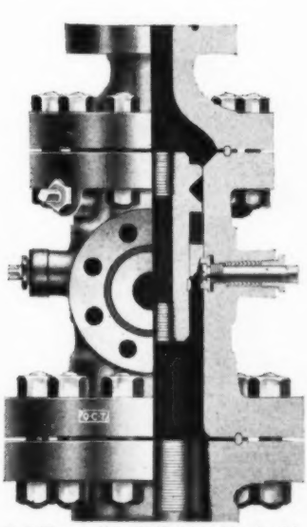


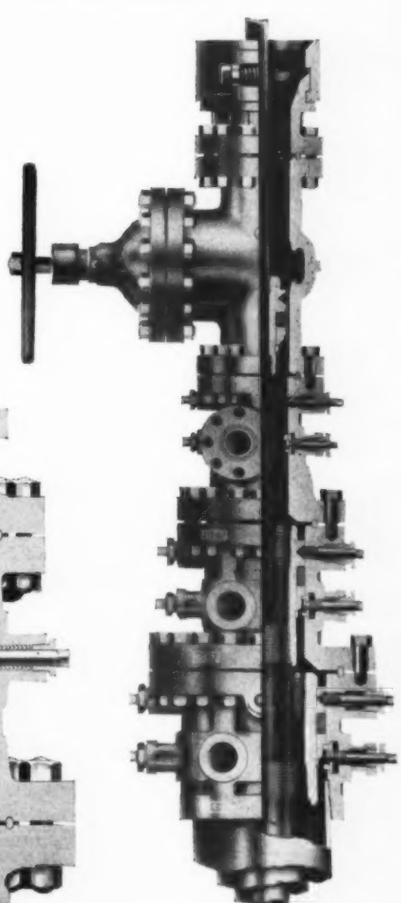
O-C-T type "Q-5" Tubing Head, having same body design as type "Q" but providing slips for suspension of tubing string.



O-C-T type "Q" Tubing Head with threaded connections for casing and Christmas-tree.

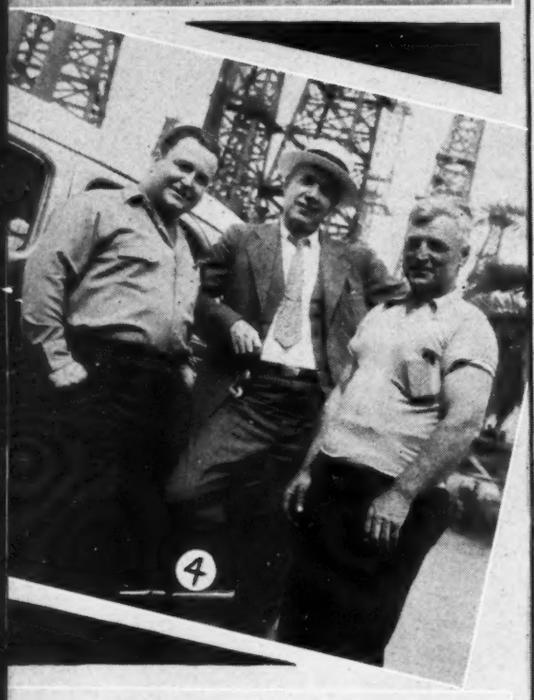


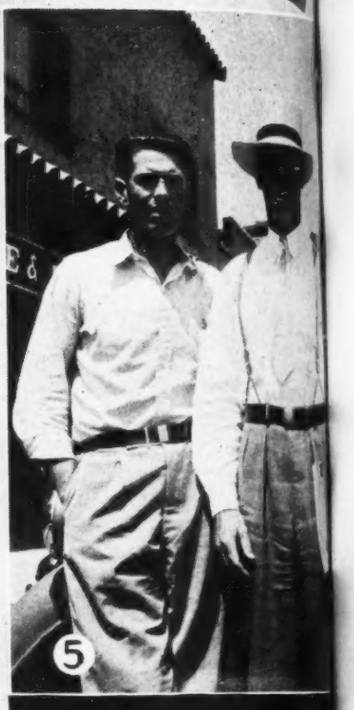
O-C-T type "Q-6" Tubing Head with flanged Christmas-tree and Casing Head connections, designed to fit O-C-T types "QB", "QC", "C-3", or "C-3-F" Casing Heads.



O-C-T type "Q" Tubing and Casing Head hook-up, showing tubing hanger passing through master gate valve.

U. S. PATENT NO. 2016454-2046579





1. Taken in the Corpus Christi, Texas, field, the photograph shows, left to right: L. Lowrey, E. W. Saybolt & Co., oil inspectors; C. E. Ingram, of the same organization, and J. S. Feroe, superintendent blending plant, Hanlon-Buchanan, Inc.

2. Bill Hogan of the Argo Oil Co., Lance Creek, Wyo.

3. Officers of the newly organized association of Michigan geologists and engineers. Standing (left to right): Al Clark, Mt. Pleasant, secretary-treasurer; Ben F. Hake, Gulf Refining Co., Saginaw, chairman program committee; W. A. Thomas, McClanahan Oil Co., chairman arrangements. Seated: Dr. R. A. Smith, state geologist, Lansing, vice-president; and Dr. Robt. B. Newcombe, Associated Petroleum Co., president.

4. Left to right: W. L. Long, owner of the Pioneer Engineering Company; C. E. Anderson, independent operator; and I. L. Bertrand, rig building contractor, all of Long Beach, California.

5. Pat Robertson (left), Security Engineering Company, Whittier, California; and Earl Cosner, with Perkins Oil Well Cementing Co., Santa Fe Springs.

6. T. H. McCay, general superintendent, Hogan Petroleum Company, Bakersfield, California, and his favorite mount.

7. J. V. Wicklund Development Company's State No. 1 well in Gladwin County, Michigan, a wildcat which, brought in four miles north of a commercial field, was responsible for Michigan's most active January-February drilling campaign in history.

THE Petroleum Engineer

MARCH, 1937

New Gas Line Laid Amid Difficulties

By FRANK H. LOVE

Quicksand, almost incessant rains and swamps among factors demanding engineering skill in construction of Humble's carrier from the Tomball field to Houston, Baytown, Port Arthur, and Port Neches

LAYING a pipe line through quicksand, marshes, and swamps, and overcoming conditions resulting from virtually a month's rain, the Humble Oil and Refining Company has completed its 10-in carrier for the transportation of gas from the Tomball and Anahuac fields to industrial centers at Houston, Baytown, Port Arthur, and Port Neches, Texas. The main line is 130 miles in length, and a total of 80.8 miles of gathering line, varying in size from 2½ in. to 14 in., has been laid. Although Tomball and Anahuac are the only fields tied into the line at present, connections will be made later with the Dickinson, West Beaumont, Cotton Lake, and Turtle Bay fields.

In constructing its gathering system the predominant idea of Humble officials was avoidance of all possible wastage of gas. At Tomball, where the system is connected to more than 50 gas wells and 250 oil wells, with 75 to 100 wells yet to be drilled, a natural gasoline plant is being constructed and before entering the main transmission line all gas will be stripped of its gasoline content. The plant will provide three stages of compression, and gas produced with oil will be utilized first, being taken at atmospheric pressure and boosted to 800-lb. pressure. When this gas is consumed additional demand will be supplied by the high-pressure gas wells. Gas from this latter source will be passed through the plant at well pressure and the gasoline content extracted.

In the Tomball field alone 75 miles of gathering lines have been laid. It is in reality a double gathering system, one, the vacuum lines, going to the oil wells, and the high-pressure lines to the gas wells. Both are laid in the same ditch. Vacuum lines vary in size from 14 in. down to 6 in., and the high-pressure lines range from 6 in. down to 2½ inch.

Precaution has been taken against

Illustrative of certain soil conditions through which a portion of the line was laid

In making a 4200-ft. crossing of Old River the pipe was first roll-welded into 300-ft. sections on both banks of the river

there ever being a time when, due to the gasoline plant being down for any reason, the gas supply would be shut off entirely. This problem has been solved by tying all high-pressure lines together and connecting them to the main line approximately 500 ft. from the plant. In this manner it is possible to by-pass the plant and send the gas directly into the trunk line should the occasion require. As a further precaution three gas wells in the Anahuac field are tied into the trunk line by an 8-inch line. In event a break should occur between the Tomball field and the point where the connection is made the entire gas requirements could be obtained from Anahuac.

Initial construction work on the main line was begun December 16. Subsequently other crews were added and from February 1st until the project was completed four crews were in operation. During January, 26 days of rain greatly retarded progress, and considering this factor, together with the condition of the soil through which the line was laid, exceptionally rapid time was made.

At the outset it was decided to lay the line by the "stovepipe" method, the soil being of such soft nature that it would be impossible for the tractors to handle long sections without the weight causing them to sink into the mud and sand to such depth as to render them inoperative. The procedure followed was for two tractors to place a joint of pipe on skids above the ditch, a clamp being applied to hold the ends in position, and the tack weld made. The ringer bead followed, then the second bead, and the finish bead. Employing this method approximately one-half a mile daily could be averaged by a single crew. The pipe used on the main line was 40.48-lb. grade B seamless, random 40-ft. joints. Inasmuch as the pipe was coated prior to being strung, sacks containing excelsior were placed on the skids to protect against damage while welding. Between Baytown and Port Neches the pipe was strung with trucks and tractors, and between the Tomball field and Houston by trucks and teams, the condition of the soil determining the method. Electric arc welding was employed throughout, and the pipe was laid in a ditch 24 in. to 30 in. in width and given a 26-in. covering.

Numerous river and bayou crossings added to the difficulties of the line's construction, including Hilderbrandt's Bayou, which with marshes was 8000 ft. in width; Cedar Bayou, 120 ft.; Turtle Bayou, 120 ft.; Taylor's Bayou, 140 ft.; Old River, 4200 ft.; Trinity River, 400 ft.; and Lovell's Lake, 600 feet. One particularly difficult crossing was between Cove and Wallisville. In reality it was a series of crossings. First 1300 ft. of swamp was crossed, then Old River (4200 ft.), followed by an 8000-ft. island, the Trinity River (400 ft.), and another swamp 1300 ft. in width. In making the Old River crossing the pipe was roll-welded into 300-ft. sections on both banks of the river. The sections were then buoyed on pontoons and pushed into the river by means of tractors. As each section was pushed its full length into the river another section was welded to it on shore and the procedure continued. This operation was performed from both banks and when the ends met in the center of the river they were picked up, placed on a barge, and welded together. A 1000-lb. river clamp was placed on each joint of pipe and when the final tie-in was made the pipe was lowered to the river bed.

On all river crossings a heavier weight pipe was used and a special coating applied. Such sections were given a primer, a coating of hot enamel, Osnaburg wrapper, asphalt, and kraft paper wrapper, the principal departure from that used on the remainder of the line being the application of the Osnaburg wrapper. The latter is a fabric that in appearance somewhat resembles burlap and serves to reinforce the enamel in much the same manner as steel reinforces concrete in building construction.

One particularly difficult strip of quicksand was encountered near Fannett. Here the ditch filled almost as quickly as it could be dug by hand. A dragline equipped with a clamshell was necessary and even then it was not always possible to keep the ditch open until the pipe could be laid. When all methods of keeping the quicksand removed from the ditch failed stompers were employed to force the pipe to the bottom of the ditch. These stompers consisted of 3-in. timbers fastened together with U-bolts, the bottoms grooved to fit the contour of the pipe, and the grooves padded with sacks of sawdust to prevent damage to pipe coating. The stompers were placed on

Lowering-in a section of the main line

Only the joints were coated in the field. Here is shown a holiday detector being used on a newly-coated joint

the line pipe and upon them was driven a tractor. By rocking the tractor the pipe was forced through the quicksand to the bottom of the ditch.

The method adopted for coating the pipe was one that has experienced a marked gain in general favor during recent months—application of the coating at central plants rather than in the field. Those who have used this method point out its advantages as being the elimination of inefficient application in the field, the loss of time that may be caused by bad weather conditions, wastage of coatings, etc. Stationary cleaning, coating, and wrapping equipment that also is light enough to be portable have made possible this method. On the Humble job central plants were established at convenient points. The plant sites were selected according to their accessibility to shipping points, as well as to the nearness of roads to the right-of-way, and similar factors. It so happened that the firm doing the coating contract has its headquarters at Houston and considerable of the work could be performed there. Other central plants were established at Mt. Belvieu, Liberty, and Port Acres for coating the main line pipe, and in the Tomball field for coating the gathering lines.

The contract called for the application of a primer coat, two coats of hot enamel, 15-lb. asbestos felt, and 60-lb. kraft paper. Upon receipt of the pipe at one of the central yards it was placed on priming racks and cleaned by scraping and wire-brushing of any foreign matter that may have collected on its surface in transit from the mill, after which the priming paint was applied with a spray gun. When dry it was ready for the coating and wrapping machine. Coating and wrapping were accomplished in one operation. A series of tables and rubber rollers fed the pipe into the machine, approximately three joints being in the machine at one time in various stages of completion. Two coats of enamel were applied by the flooding method at a temperature between 420 to 450 deg. fahrenheit. The total thickness of the enamel was 5/64 inch. The enamel was flowed onto the pipe from overhead outlets, the surplus returning to the machine pot for recirculation. It has been found that this surplus enamel heats the pipe to such a degree that better adhesion is obtained, thus eliminating possible holidays.

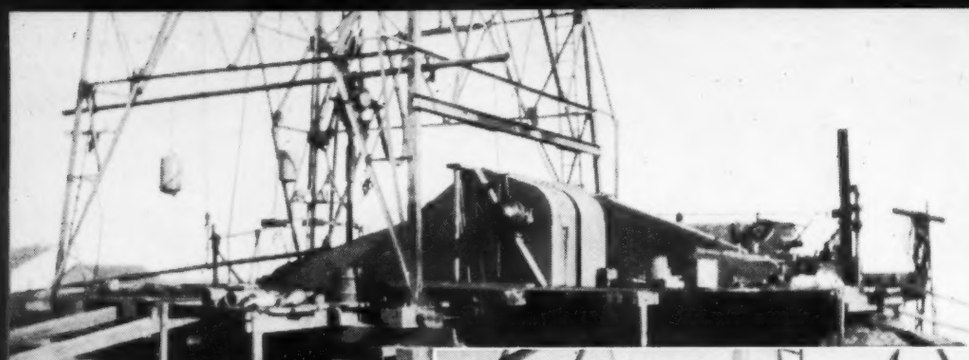
Following the second coating of enamel the asbestos felt wrapper was applied spirally while the former was still warm and pliable, resulting in a bonded wrapper. After the pipe left the machine it was placed on cooling boards where it remained for approximately 30 minutes, or until such time as the heat had completely left the pipe and coating. Inasmuch as the Humble line was an electric-welded job the ends of each joint were left bare, to be coated and wrapped in the field after being welded into the line.

Other factors in connection with the construction of the line were the casing of all railroad crossings with 18-in. pipe and all highway crossings with 14-inch. These of course were vented. Gate valves were placed at points where it was thought future connections might be made. When completed the line was tested with 1000-lb. gas pressure. The main operating site will be a company camp now under construction just out of Houston on the Beaumont highway. Complete telephone facilities are being provided throughout.

Contractors for the laying of the main line were the Apex Construction Company and the Oklahoma Contracting Company, the former also having the contract for the gathering system. The coating was done under contract by Mayes Brothers, Inc. H. C. Price, Inc., had the contract for electric welding that portion of the main line laid by the Apex Construction Company.

The Fluor Corporation, Ltd., have the contract for the building of the gasoline plant.

One of the central plants where the pipe was coated and wrapped



Left—Typical installation of unitized rig used in drilling operations in the new Sulphur Bluff oil field in Hopkins County, Texas. Note absence of concrete derrick foundations

Right—Pumping installation at the discovery oil well in the Sulphur Bluff field, Hager, Luse & Russ No. 1 J. E. Worsham

Development Practice in th

By JOS. A. KORNFELD

DIFFICULTIES in drilling vertical holes caused by a major fault, completion difficulties resulting from low-formation pressures, and rugged topography have not hindered progress in the new fault-line development at Sulphur Bluff in Hopkins County, Texas. Since the discovery well was brought in on July 10, 1936, 25 consecutive flowing oil wells have been completed by six operators, and at this writing there have been no dry holes to mar the record. (The discovery well was on the pump for a short period, but it is again flowing by natural means.) This record has been made possible by careful use of subsurface geologic control, care in completion, and conservative, logical development within known productive contours.

The Sulphur Bluff field was discovered by Hager, Luse and Russ. This company acted on the recommendation of Dilworth S. Hager, an authority on the geology of the Balcones Fault zone. Discovery well No. 1 J. E. Worsham when completed had an initial production of 300 bbl. of oil a day flowing through 2½-in. open tubing from the Paluxy sand, the top of which was found at 4470 ft. and penetrated to 4500 feet. It marks the discovery of the second pool in the Paluxy sand (upper member of the Trinity formation, Lower Cretaceous) in the Mid-Continent area. The other is the Talco field in Titus and Franklin counties to the east. At Sulphur Bluff the only geologic control was four shallow tests drilled to the Woodbine formation of Upper Cretaceous age.

The field is two and one-half miles south of Sulphur Bluff and nine miles northeast of the town of Sulphur Springs, in the northeastern part of the county. The nearest production is at Talco, 14 miles to the east. Production is confined at present to the Alex O. Wetmore and James A. Craft surveys.

Of importance from an engineering standpoint is the unusual geologic structure of the field. It is believed that accumulation of oil and gas is caused by the presence of a local segment of the Talco-Mexia fault, the fault limiting production at the north end of the field and salt water limiting production on the south and probably also on the east and west. The angle of the fault plane is 45-deg. to the south, and the strike of the fault N 80 deg. E. The water level in the sand is at a depth of 4135 feet sub-sealevel. The field has a great thickness of producing sand, as much as 98 ft. of solid sand having been penetrated. Sand of maximum saturation was found in Hager, Luse and Russ well No. 1 Rooney Long in the Alex O. Wetmore survey. This well penetrated sand from 4420 to 4518 ft., and the bottom of the hole was still 60 ft. above the mean water level. Although the producing formation appears to be comprised of a single stratum of sand, a shale break is found in some of the wells, but not at a uniform interval from the top of the sand. Cores taken from the wells show an extremely fine quartzitic sand. The upper part of the sand is uniformly pure and is composed of small grains; the lower part grades into coarse impure sand mixed with large pebbles of white chert.

Cumulative production to date on the Hager, Luse & Russ J. E. Worsham

in the Sulphur Bluff Field

Faulting causes difficulties in drilling—and low reservoir pressure calls for care in the completion of wells

lease, which has eight wells, is in excess of 15,000 bbl. per well. Present proration restrictions are based 50 percent on acreage and 50 percent on potential. Allowable for the field for the month of March, 1937, is 2375 barrels. The largest potential so far recorded in the field is that from the Hager & Luse well No. 2 J. G. Reynolds in the Alex O. Wetmore survey, which showed an output of 600 bbl. a day, producing through a ¼-in. choke. The largest initial production, based on an unofficial gauge, was made by the Hager, Luse and Russ well No. 1 Rooney Long in the Wetmore survey, a production of 128 bbl. having been reported for the second-hour gauge.

The casing program followed in the field is comparatively simple. Surface conductor, composed of either 10-in. 40-lb. or 12½-in. 50-lb. casing, is set at a depth between 44 and 100 feet. The oil string is composed of 7-in. 22-lb. or 24-lb. casing set at depths ranging from 4435 to 4539 ft., depending on the structural position in the field for casing seat. Practice with regard to the tubing string calls for 2½-in. 6.5-lb. tubing.

Regular practice is following in coring, the average core measuring 2⅞ in. in diameter. Of ten wells drilled the average penetration into the producing sand is 47 ft.; this is believed to be a fair average for the field.

Cementing practice in the field is to set the 10-in. or 12½-in. surface pipe with 75 sacks of cement; 350 sacks of cement are used in setting the oil string. The regular 72-hour period is allowed for setting of the cement.

Straight-hole surveying is simplified. An acid bottle is run at intervals of 250 ft., beginning at a depth of 500 feet. A maximum deviation of five deg. from vertical is required of the contractor. Necessity for frequent checking of verticality is occasioned by the existence of a major fault throughout the north side of the field. In this connection, the number of rock bits used may vary from three to as many as eight on a single well, depending on where the fault is found and the thickness of Georgetown lime encountered.

TABLE I

Analysis of Core from the Discovery Well of the Sulphur Bluff Field

(Run by Core Laboratories, Inc., Dallas, Texas)

COMPANY—Hager, Luse and Russ — SUBMITTED FOR—Leon F. Russ
WELL—Worsham No. 1 — SUBMITTED BY—G. C. Tisdale
LOCATION—Wetmore Survey, Hopkins County, Texas — ANALYST—William L. Horner

NO.	DEPTH	PERMEABILITY (Millidarcys)	POROSITY (Percent of pore volume)	CHLORIDE (ppm. in residual pore water)	RESIDUAL OIL CONTENT (Bbl. per acre ft.)	SATURATION (Percent of pore volume occupied by residual fluid) Water	Oil
1	4464-94	1,530	25.0	1,520	675	9.3	34.8
2	4464-94	1,330					
3	4464-94	*754					

*Perpendicular to bedding planes.

REMARKS—The above samples were received in a partly closed glass jar in which they had been stored for several days. Low water content values such as the above are often due to exposure weathering.

The resistivity of such sand is very high.

The high oil content, together with the other data, indicates good oil productivity; however, a core-graph compiled from work on many samples is necessary for a complete knowledge.

Faulting will influence the thickness of Georgetown lime to be drilled.

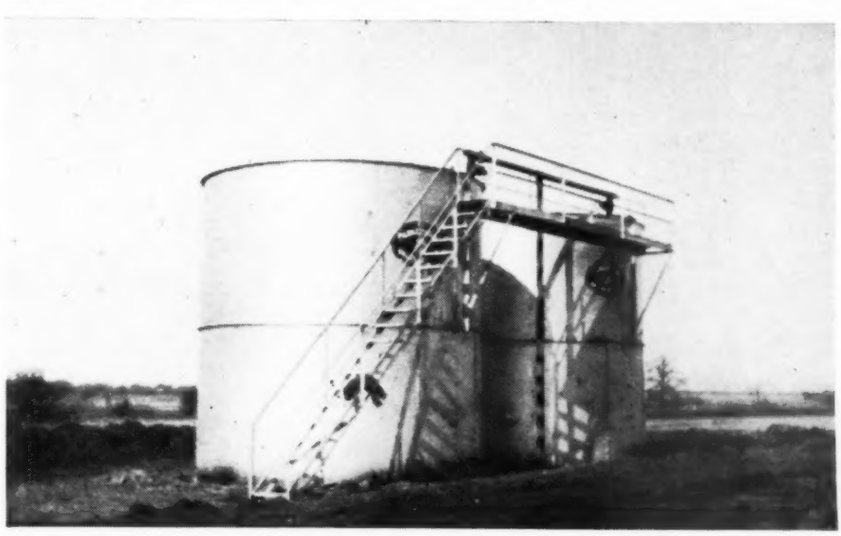
Drilling time has been reduced sharply as compared with that required for the first wells in the field. The discovery well took 25 days to drill, whereas but 13 days were required to drill Hager, Luse and Russ well No. 1 Jeff M. Worsham in December of last year. This includes the time from spudding-in to completion of the well.

Low formation pressure characterizes the Sulphur Bluff field. The average flowing pressure is only 90 lb., varying from 75 to 125 lb. on tests made to March 1. Shut-in pressures will average 300 pounds. Because of the low pressure, at least one drilling contractor uses oil in completion operations.

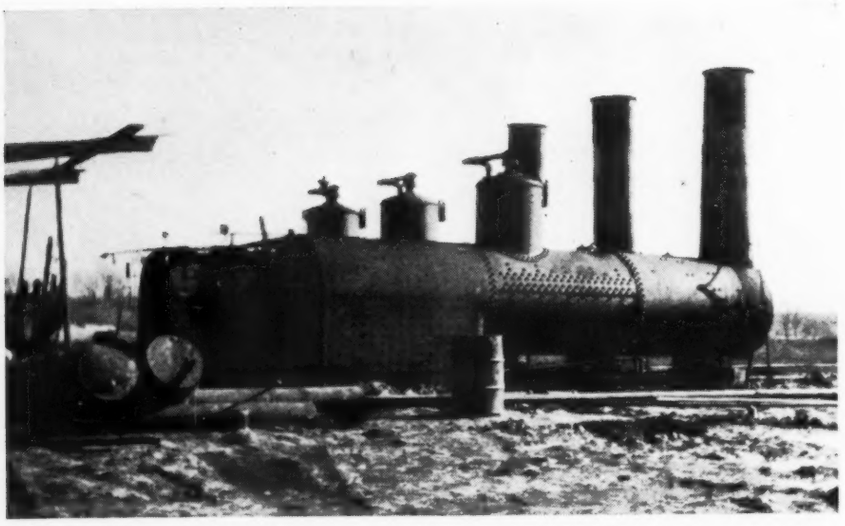
Steel derricks 122 ft. high, unitized 8-in. drawworks, 27-in. rotary, and 18-in. slush pumps are in general use for drilling. The present average cost for a completed well is $20,000.

In drilling operations the principal markers recorded are as follows:

Pecan Gap Chalk	1528 ft.
Woodbine Sand	3390 ft.
Georgetown	3680 ft.
Paluxy Sand	4480 ft.



Standard installation of tank battery in the Sulphur Bluff field. This is typical of two tall 500-bbl. tank combinations



Typical boiler battery in the Sulphur Bluff field. Standard practice calls for 125-hp. boilers. Water supply is obtained from five of a group of nine lakes in the field

A summary of wells on production on March 5, shows the following:

Hager, Luse and Russ, Dallas, Texas	11
Hager & Luse, Dallas, Texas	3
Walter L. Goldston, Houston, Texas	4
Empire Gas and Fuel Company, Bartlesville	3
F. D. Jones, Dallas, Texas	3
Shell Petroleum Corporation, Houston, Texas	1
Total	25

At the time this was written seven rigs were running in the field. Drilling contractors operating in the field include F. D. Jones, Ray Richards, Big State Oil Corporation, and Fosdick.

Acknowledgment is made and thanks extended by the author to Leon Russ and D. B. McBride, of Hager, Luse and Russ, for information on cores and other basic data; to F. D. Jones, contractor, for information on equipment; to Core Laboratories, Inc., for report on core analysis; and to the American Liberty Pipe Line Company for data on market outlet.

TABLE 2

Analysis of Sulphur Bluff Crude

Run by Eastern States Petroleum Co., Inc., Houston, Texas, August 24, 1936

	YIELDS
Gravity 25.0	7.5% 300 endpoint gasoline
BSW .2%	9.0% 325 endpoint gasoline
Sulphur 1.11%	11.0% 350 endpoint gasoline
	12.5% 375 endpoint gasoline
	14.5% 400 endpoint gasoline
	or
	14.5% 400 endpoint gasoline
	6.5% 525 endpoint kerosene
	9.0% No. 2 heating oil
	69.0% fuel oil
	1.0% loss

TEST ON 325 ENDPOINT GASOLINE

Gravity	75.0
V.P.	7.8
I.B.P.	95
10%	136
50%	182
90%	273
Endpoint	328
Recovery	95%
Octane	57.1
Doctor	Sweet

Derrick-floor elevations vary from 429 to 443 ft. above mean sea level. In development of the field along the north side, certain wells were drilled the spacing of which was irregular rather than uniform in order to avoid drilling beyond the safe productive limits of the fault. When the well cuts the fault in the lower part of the Georgetown lime it is a danger signal to the operator that the hole is beyond the safe productive limits of the fault. Additional locations are then made down-dip.

The principal pipe line outlet is provided by the American Liberty Pipe Line Company, which gathers the crude through 4-in. and 6-in. lines and delivers it to the Talco station where it is received in a 55,000-bbl. storage tank. There the oil is mixed with Talco crude, resulting in an oil of 22.5 deg. A.P.I. gravity oil, which is transported by railroad tank car to Houston. On the Houston Ship Channel at the company's marine loading terminal the crude is loaded into tankers for coastwise shipments and export trade. Sulphur Bluff crude varies in gravity from 23.5 to 25.0 deg. A.P.I., and Talco crude from 14 to 20 deg. A.P.I.

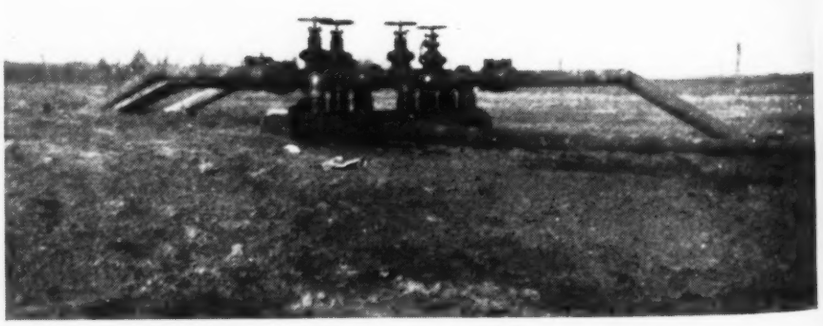
One large producer in the field markets its crude from a tank car loading rack at Hager Switch on the Cotton Belt railroad in proximity to the field.

TABLE 3

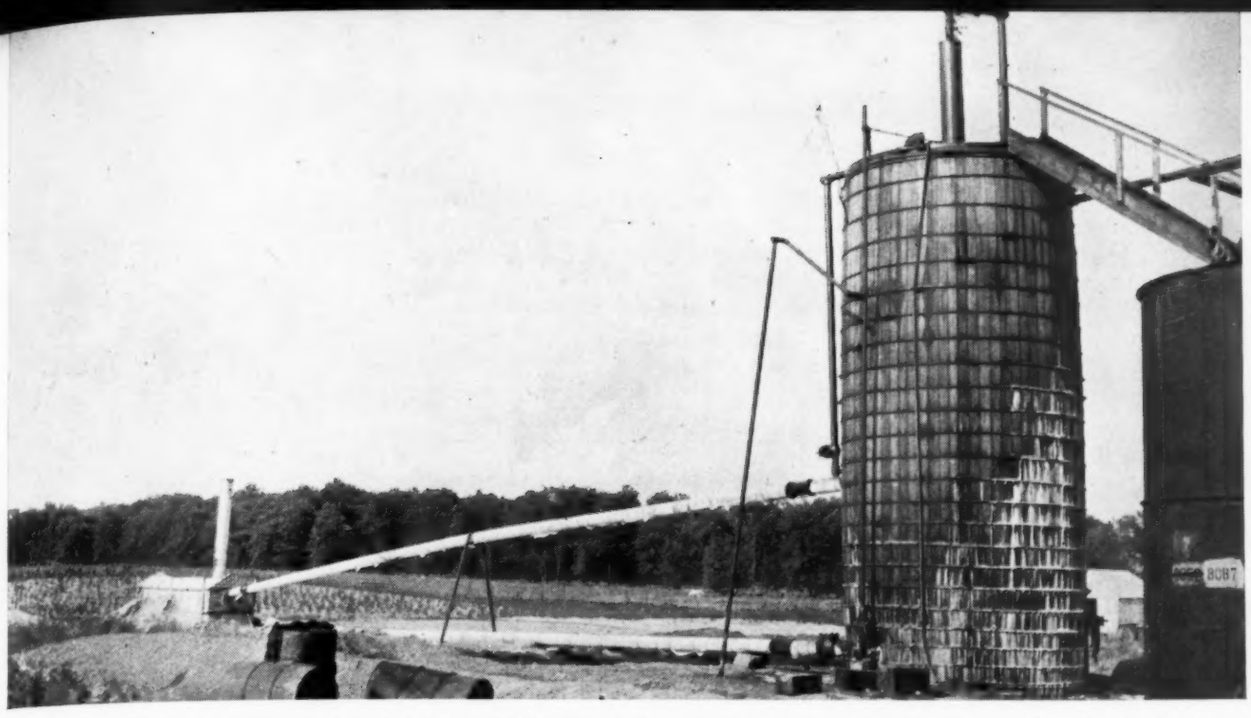
Sulphur Bluff Oil Field, Hopkins County, Texas

Table showing results of 24-hour potential tests. Tests made through ¼-in. tubing choke:

Operator	Well	Number	Bbl.	Pressure CSG.	Pressure TBG.
Empire Gas & Fuel	J. E. Worsham	2	623.45	140	140
Walter Goldston et al.	Smith	1	463.00	125	75
Walter Goldston et al.	Smith	2	494.00	100	90
Walter Goldston et al.	Smith	3	466.00	125	100
Hager & Luse	Reynolds	1	462.16	30	80
Hager & Luse	Reynolds	2	626.19	105	120
Hager, Luse & Russ	J. E. Worsham	6	540.89	135	135
Hager, Luse & Russ	J. E. Worsham	8	286.69	105	120
Hager, Luse & Russ	J. M. Worsham	1	427.54	125	125
F. D. Jones Drilling Co.	Pierce	1	393.70		95



Manifold connections on field pipe line outlet in the Sulphur Bluff field



Single heating furnace employed by Pure Oil Company to remove water and emulsion from oil in Crystal Field, Michigan. One furnace only is required with wooden settling tanks

Separation and Disposal of Salt Water in Michigan Fields

Wooden tankage for separation of oil and water by heat has reduced amount of fuel required—salt water is all disposed of underground in stratum of glacial drift

By
J. C. ALBRIGHT

SINCE bringing-in the discovery well in the Crystal Field, Central Michigan, on January 28, 1935, many wells have gone to water, or are making only a small fraction of their flush oil production. The Dundee Lime, penetrated in this field by the company that discovered the field, all over the state has produced tremendous volumes of water when drilled into in search of oil. When the field was in its flush stage in the summer of 1935, many wells whose production of oil was satisfactory were pinched back to retard the encroachment of salt water. Proration of the field has never been satisfactory, because of disagreement among the producers on just what proration meant. Many of these producing companies were directly, or indirectly, controlled or connected with refineries that had a limited supply of charging stock, which condition ultimately resulted in all wells being produced to capacity.

Water encroachment made itself felt during the summer and fall of 1935, and by the turn of the new year began to assume serious proportions. Many devices, all of which employed heat, were constructed to effect a satisfactory separation of the oil from the water. Except for obtaining and maintaining the proper degree of heat in the separators and in the primary settling tanks, treating the oil has not been found to be a particularly difficult problem. The gravity of the oil is exceptionally high, running from 44 to 48 deg. A.P.I., but the wells themselves produce little gas. The average temperature of the oil as it enters the flow lines from the well is around 44 deg. fahr., and requires considerable fuel to raise it to 135-150 deg. fahr., the temperature needed for efficient separation.

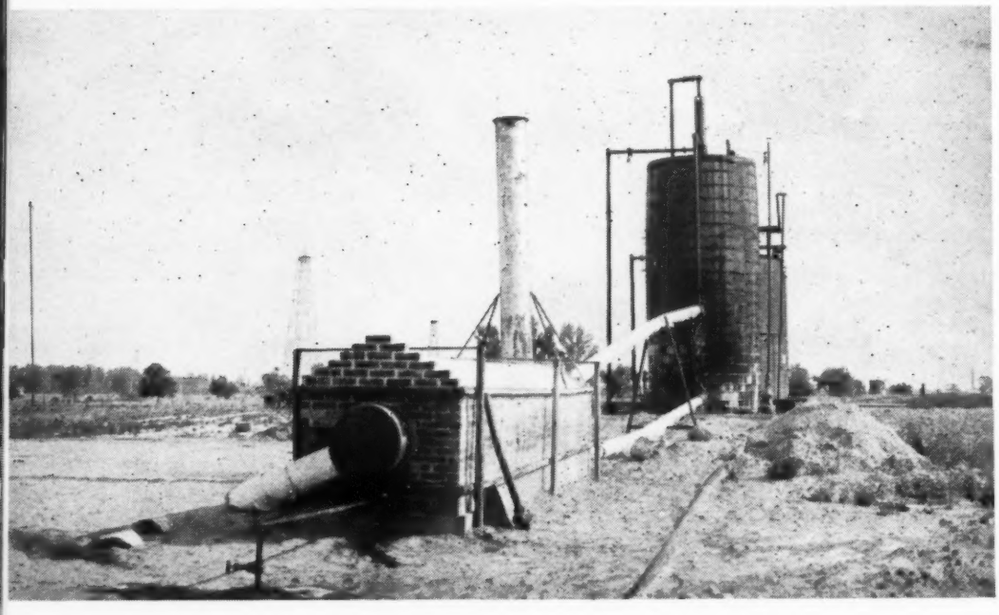
Fluid production (water and oil) in the field is estimated at approximately 32,000 bbl. daily, from which only about 8,000 bbl. of oil are recovered. After separating the oil from the water, there remains approximately 24,000 bbl. of water daily; and this must not be disposed of by impounding in surface ponds for disposition by evaporation or any other means. The requirements of the State Conservation Commission are that salt water must be disposed of in a manner not to contaminate the many lakes and streams in the state, making it imperative, especially in the Crystal field, to return the salt water to the base of the glacial drift through wells drilled especially for water disposal, or into wells that have been plugged-back from the Dundee lime.

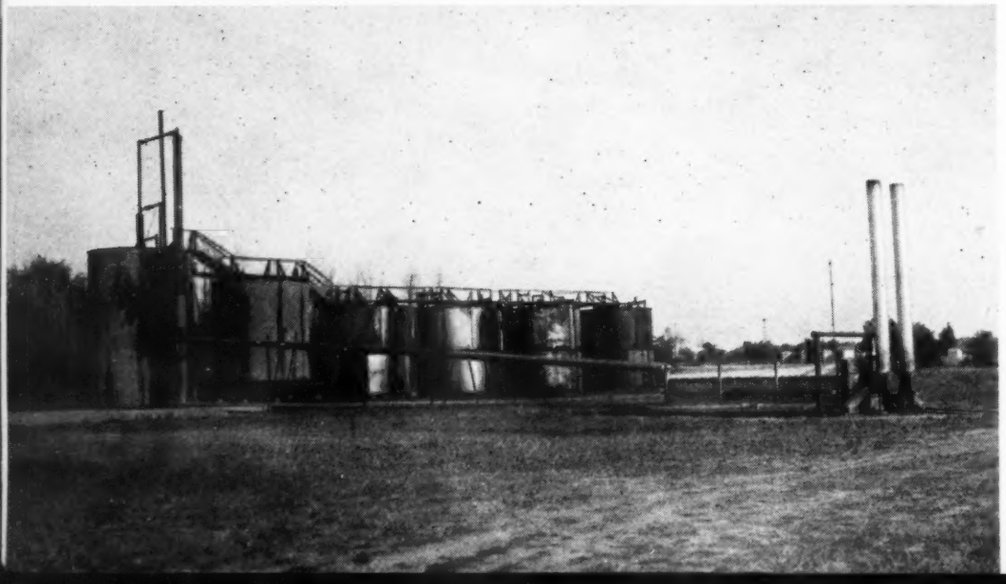
For use in separating water from oil in this field particularly, the Pure Oil Company has developed a dutch-oven heater that employs the circulation of water and oil by thermo-syphon action. Production from as many wells as is practicable is led through the field lines from the well heads to a central receiving tank that is connected directly to the dutch-oven heater. Large diameter lines are utilized to carry the oil to the heaters and from them back to the tanks. Insulation is used invariably to maintain the heat on the oil and water mixture as it flows back to the separating tanks. This type of unit is used largely by the Pure Oil Company in the Yost and Porter fields, which offer a problem somewhat different from that encountered in the Crystal field.

Steel tankage has been used almost exclusively in Michigan fields for lease storage and for the separation of oil

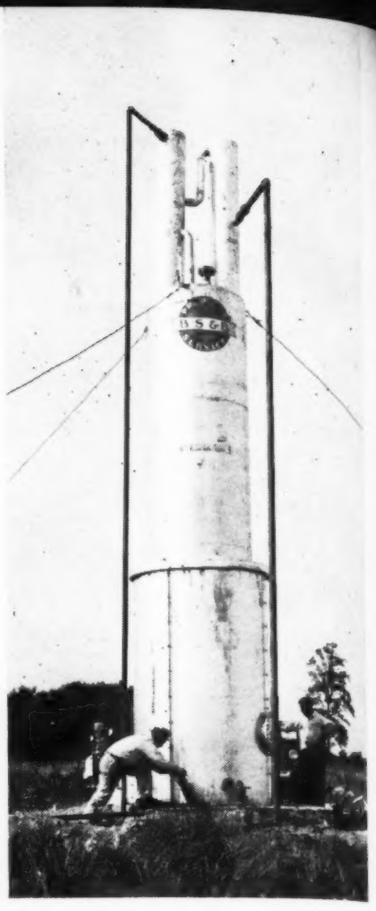
and water; however, with the all-steel equipment, it was discovered that comparatively high temperatures were required to break the emulsion in the separating tanks, and in many instances the double dutch-oven heaters were installed. In the spring of 1936, the Pure Oil Company installed a wooden "gun-barrel" tank and a double dutch-oven heater, and discovered that only about one-half the fuel was required to obtain the proper treating temperature, which with the wooden tank is about 135 deg. fahrenheit. Rapid transfer of the heat through the thin, uninsulated walls of the steel tanks prevented adequate separation unless the oil were heated to a much higher temperature, sometimes as high as 190 to 200 deg. fahrenheit. At about this time,

Firing end of single furnace heater used by Pure Oil Company in the Crystal field, Michigan, for water and oil separation. Note oil and gas separator mounted on top of wooden separation tank





Combination water separator and oil and gas separator installed on Turner Petroleum Company's Williams Lease in the Crystal pool, Montcalm County, Michigan. It handles 3000 bbl. salt water from the Dundee Lime and removes it from the oil produced from three wells on the property



or later in the year, it was discovered that the "big" water could be separated easily from the oil at 85 to 90 deg. fahr., and the remaining water at approximately five percent higher temperature.

Gas fuel in the field is at a premium, for no excess is produced with the oil above the field requirements, so the oil-treating units, whether they are constructed entirely of steel or include wooden separating tanks, are constructed so a few pounds pressure can be maintained upon them, in order that the gas can be forced through the fuel system over the entire field. No oil and gas separators are utilized in the Crystal field, except the equipment built into the treating units. Practically all operators have agreed to connect their fuel lines so that in the event one lease suffers a shortage of fuel, surpluses from other leases will supply sufficient gas for treating and carrying on normal producing operations.

A combination oil and gas separator has been developed with a heating and water-separating unit that can be, and usually is, operated at sufficient back pressure to force oil, gas, and water to any portion of the lease desired. This unit, developed by Black, Sivalls & Bryson, Inc., is made in several sizes to handle different volumes of water. Heat is applied by means of a ring-type burner, which surrounds the base of the vessel, the flames and heat traveling upward on the outer surface of the metal. An insulated jacket is placed around the treating unit, and provides means of retaining heat, and serves also as a combustion chamber. Some of the units installed in the past six or eight months were constructed with a double oil and gas separating attachment on the top of the vessel. The fluid (oil, gas, and water) flows from the well or wells into the first of the gas chambers, and oil and water drop down into the body of the treat-

Double furnace oil heater used by the Pure Oil Company in the Crystal field to remove water and emulsion from the oil. Double furnace needed because of rapidity of oil and water cooling in steel tanks

ing tank. Gas with some entrained oil and moisture passes over to the second separator, the liquids dropping down and the gas passing out to the fuel lines on the lease.

An improvement that only recently has been installed consists of a water-leg that is separate from the treating unit and into which the oil, gas, and water flow before being treated for the removal of emulsion. A fluid-tight jacket is provided for this water-leg so that either oil or water may be passed through it from the base of the heater. In most installations in the Crystal field, water is used to circulate through the jacket, as the volume is larger. The purpose of the water-leg is to pre-heat the incoming oil and water to a temperature sufficient for the "big" water to be precipitated before it enters the main vessel of the treater. A treater operated at a temperature of approximately 135 deg. fahr. and on a property with a gross production of 3000 bbl., of which 2250 bbl. is water, will "knock out" most of the water in the water-leg.

As the oil and water as it comes from the wells is at a temperature of less than 50 deg. fahr., the year round, the exchange of heat in the jacketed water-leg may be sufficient to remove most of the water, which is estimated at about 95 percent of the total fluid. Except in extreme cases, when temperature conditions are such that heating is difficult, a small amount of treating compound is introduced into the liquid, and this only in the winter months. With most of the water removed prior to introducing the fluid into the main body of the treater, vapor losses are minimized and the gravity of the oil maintained at approximately that of production at the well head.

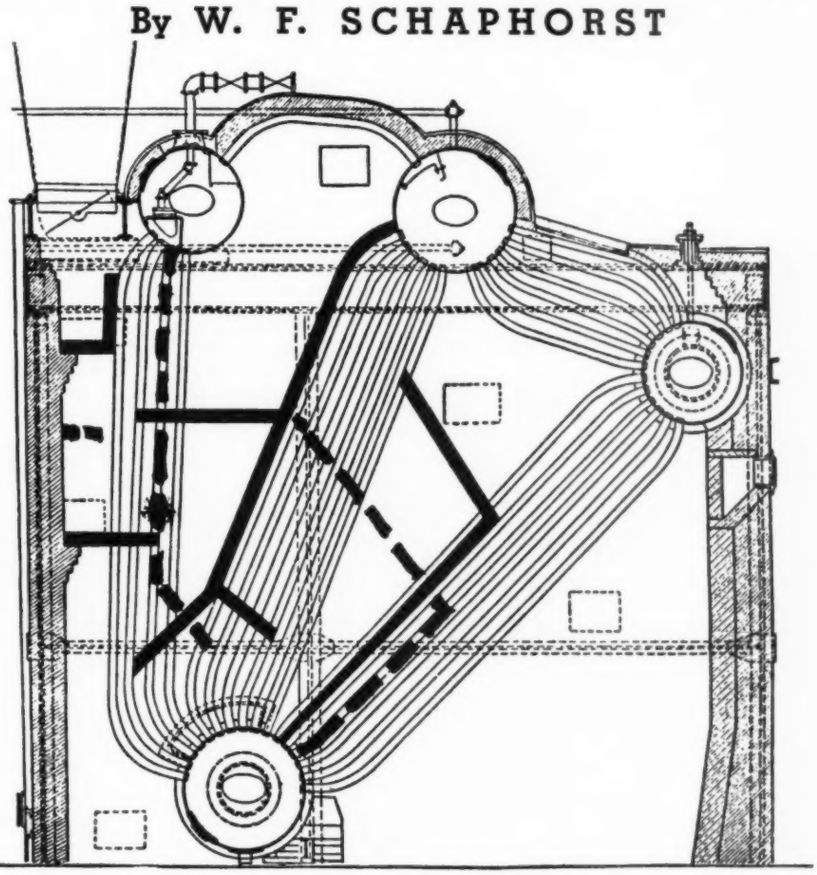
With the all-steel thermo-syphon, dutch-oven heaters, the temperature drop during settling and water precipitation were so great that excessive temperatures were maintained on the heating coils in the furnaces; this not only created an expensive vapor loss, but the high temperature combined with the concentration of salts in the water also caused rapid deterioration of the equipment. Salt water produced with the oil in the Crystal pool has a weight ratio of three to two; in other words, two gal. of water weighs as much as three gal. of oil.

Salt water is disposed of by pumping it or forcing it by separator pressure, into the glacial drift. Producers who treat the oil at low pressure must pick the free water up with steam or gas-engine-driven pumps and deliver it to the disposal wells under a pressure sufficient to disperse it into the gravel at the base of the drift. Treaters operated under pressure often will force the water to the wells with a satisfactory pressure, making it possible to dispense with the pumps.

How To Baffle Vertical Refinery Boilers

By W. F. SCHAPHORST

THE solid black lines on the accompanying sketch show how a vertical water-tube boiler was baffled. The method shown is not the best. The dotted heavy lines indicate a simpler and better method. Remove all baffles shown in solid black lines with the exception of a small protruding baffle close to the damper, which cannot be shown on account of the solid line on the drawing. These dotted lines show that less baffling can be employed and that the result will be better because there is more cross flow with fewer corners to turn; besides, it usually is good practice to avoid baffles that are perfectly horizontal because they form a shelf on which ashes and soot will lodge. Difficulty often is experienced in keeping such shelves clean even with a first class soot blower. Avoid pockets also. At the left wall, as will be noted close to the damper, there is a pocket that can be eliminated.



Another objection to the baffling in the boiler is that it is *solid;* that is, it is cast in one piece. The principal fault with solid walls is that they are too stiff. On account of the continual expansion and contraction of a boiler due to heating and cooling it is desirable that the baffle walls be able to accommodate themselves to such changes. In other words, baffle walls should be *flexible*, and at the same time they should maintain themselves in a tight condition so that gas leakage will not occur. Solid walls often crack and break in a short time and soon become more inefficient than the poorest tile baffles. Plastic, with leakless snake joints, generally is recommended for all kinds of water-tube boiler baffling. The joints permit expansion and contraction and at the same time prevent cracking and breaking of the baffle wall. Baffles of this type have been known to last 15 years in boilers that are operated at overload all the time; even after the 15 years they are still in good condition.

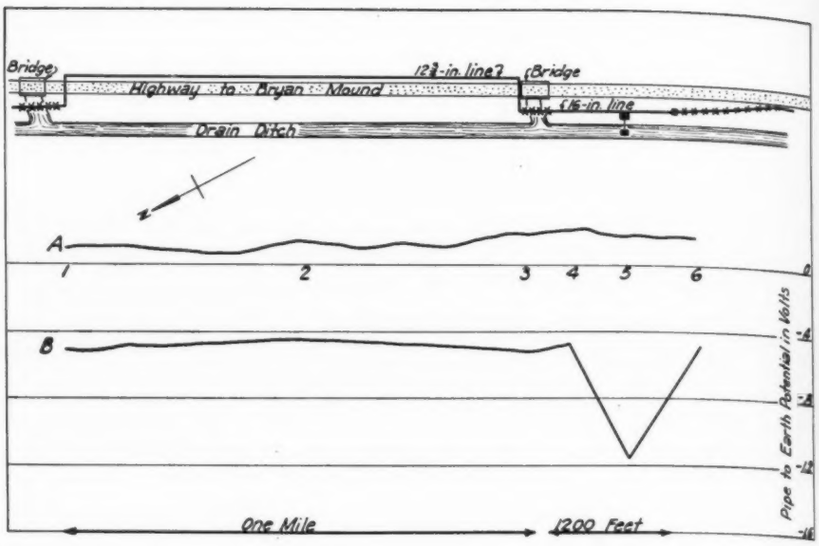


Fig. 1. Sketch of high-pressure gas line, highway, and drain ditch

By

DAVE HARRELL

Corrosion Engineer,
Houston Pipe Line
Company

A Special Cathodic Protection Unit to Overcome an Unusual Electrolytic Condition

IN 1934 one mile of 16-in. coupled gas line was removed by the Houston Pipe Line Company from beneath the east ditch of the road between Freeport and the Bryan Mound plant of the Freeport Sulphur Company. This pipe had reached such a bad state of corrosion that the company saw fit to replace it with 12¾-in. pipe coated with a high-resistance hot application pitch enamel. If the foresight had been as good as the proverbial "hindsight" the line never would have been laid in this location at all, but since this is seldom the case, the line was laid ten years ago under the east ditch of the road.

A drain ditch that drains the sulphur "Stacks" at Bryan Mound runs down the other side of the road. In the sketch, Fig. 1, showing the relative positions of the pipe line and the drain ditch it will be seen that where it was impossible to place the line on the opposite side of the road from the drain ditch it was placed on piling above ground, where it would not be in contact with the weak solution of sulphurous acid that exists in the waters of the drain ditch. Those who laid this line did not take into account, however, the fact that the loose sandy clay soil would draw this chemically active water up to the bottom of the pipe by capillary action. The result was that the bottom of the line was constantly in contact with this very highly-ionized and low-resistance soil and consequently the whole area between the sections above ground became a bad discharge area for accumulated galvanic currents.

Isolated as it was, and although painted with high-resistance coating, the mile of 12¾-in. line was not hard to protect electrically and a small wind generator with a maximum output of 120 watts was installed at Station 1 on the sketch and functioned perfectly for a period of about a year and a half. With an average wind velocity of nine miles per hour and an average output of 70 watts, a negative potential of

Fig. 2. The engine-house is mounted on four 20-ft. telephone poles. The gas meter, and 50-gal. drum for auxiliary cooling water supply are shown at the side of the building

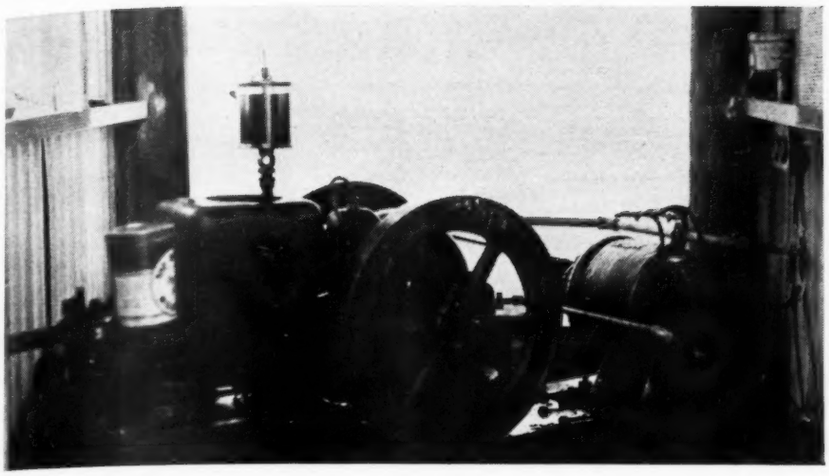


Fig. 3. Small 2-hp., 4-cycle gas engine V-belt connected to 1-kw. generator

0.3 volt between pipe and soil was maintained by the small wind-driven generator. About six months ago it was discovered that the long sleeve on the piling between Stations 3 and 4 on the sketch had become metal-bound and allowed the mile of 12¾-in. coated section to connect electrically with 1200 ft. of 16-in. line on which there was hardly any paint at all. This 1200 ft. lies immediately to the south of the bridge indicated on the sketch and between stations four and six. This added load proved too great for the small wind-driven generator and the whole line potential fell back to positive.

Fig. 4. V-belt drive on auxiliary marine pump

During the time that the wind generator had maintained protection on the coated line this 1200 ft. of sparsely painted 16-in. line had developed several bad leaks, showing that it was being actively attacked by corrosion. It was decided therefore to try to protect the entire section of both 12¾-in. and 16-in. line. Accordingly, a portable welding machine was set up at Station 5, a piece of junk 8-in. pipe was placed in the drain ditch for an anode, and the cathode connected to the line. Power up to four kw. was applied to the system, but it was found that adequate protection could be had with a current of 35 amp. at a potential of 22 volts. This yielded 770 watts, all the power necessary to do the job.

Accompanying photographs show the unit designed to render complete cathodic protection under these conditions. Fig. 2 shows the 6-ft. by 6-ft. engine-house that is mounted on four 20-ft. telephone poles. These poles also form the corner-posts of the house and 4-in. by 6-in. sills and joists plus 2-in. by 6-in. sway-bracing, some galvanized iron and some ¼-in. mesh hardware cloth complete the equipment. A board walk was built from the road out to this elevated engine mounting.

Fig. 3 shows the assembled unit installed in the engine-house. This consists of a single-cylinder, 2-hp., 4-

Fig. 5. Voltmeter and ammeter mounted on window sill to indicate generator output

Fig. 6. Float-type anode

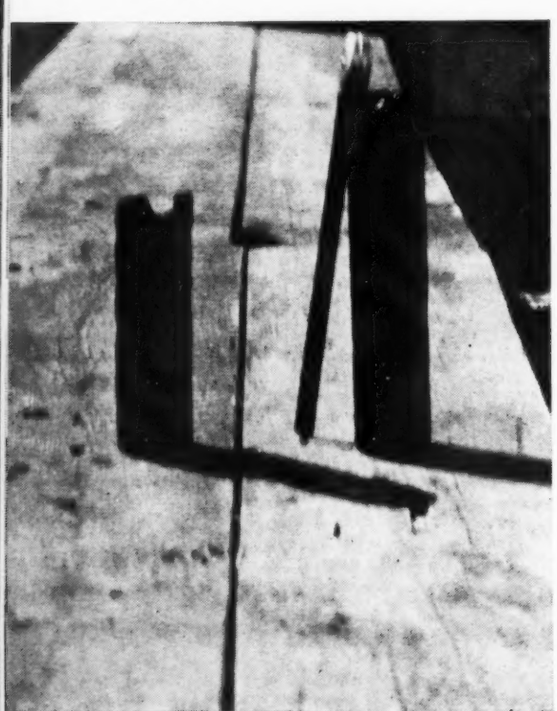
cycle gas engine driving a 1-kw., 32-volt d.c. generator by means of a belt. One of the characteristics of this type of engine is its small capacity open-jacketed cooling system, which takes advantage of the additional heat radiation to be had from the heat of vaporization of generated steam. The water in the hopper boils away in about three hours of continuous engine operation. Since it was not convenient to visit this machine more than once a day, this obviously would not do; also, the top oiling system had a reservoir that would hold sufficient oil for only a few hours' operation. Fig. 3 clearly shows the one-quart size top oiler that was installed. It empties itself in about a week of continuous operation. Fig. 4 shows a small centrifugal water pump installed to drive from the bottom "V" belt, maintaining constant circulation of the water in the hopper by picking up from the bottom of a 50-gallon steel drum (shown in Fig. 2, on the outside of the building), and returning from the top of the hopper to the top of the steel drum by means of an overflow pipe. A gas carburetor was placed on the engine, and beneath the oil can is a relay and thermostat arrangement that will stop the engine should the water in the cooling system rise to more than 200 deg. fahrenheit.

Fig. 5 shows a small voltmeter and ammeter mounted on the window sill to indicate generator output. Originally a field rheostat was used to control the generator output, but it was found that the amount of current from the generator was directly proportional to the amount of 2-in. junk pipe connected to the positive terminal and exposed to the water in the drain ditch.

This drain ditch in which the anode is placed connects with several small bayous that flow directly into the Gulf of Mexico and so maintains a water level corresponding with the tide. To compensate for the rise and fall of the water level a float was constructed as shown in Fig. 6. A hole was made in this float and 2-in. junk pipe fed through it and secured on top by means of a clamp.

After this machine had been running 30 days it was found that the speed could be reduced to about 400 r.p.m. and the voltage to 23, at which potential the current was 25 amp., or a total of 565 watts. The "A" curve on the sketch, Fig. 1, illustrates the bad positive condition that existed prior to the installation of the unit, while the "B" curve shows the excellent negative condition that has been maintained by this unit for the past six months. The shot point Stations where readings are made periodically are indicated by the numbers from one to six on the zero line. The engine-generator set is at station five.

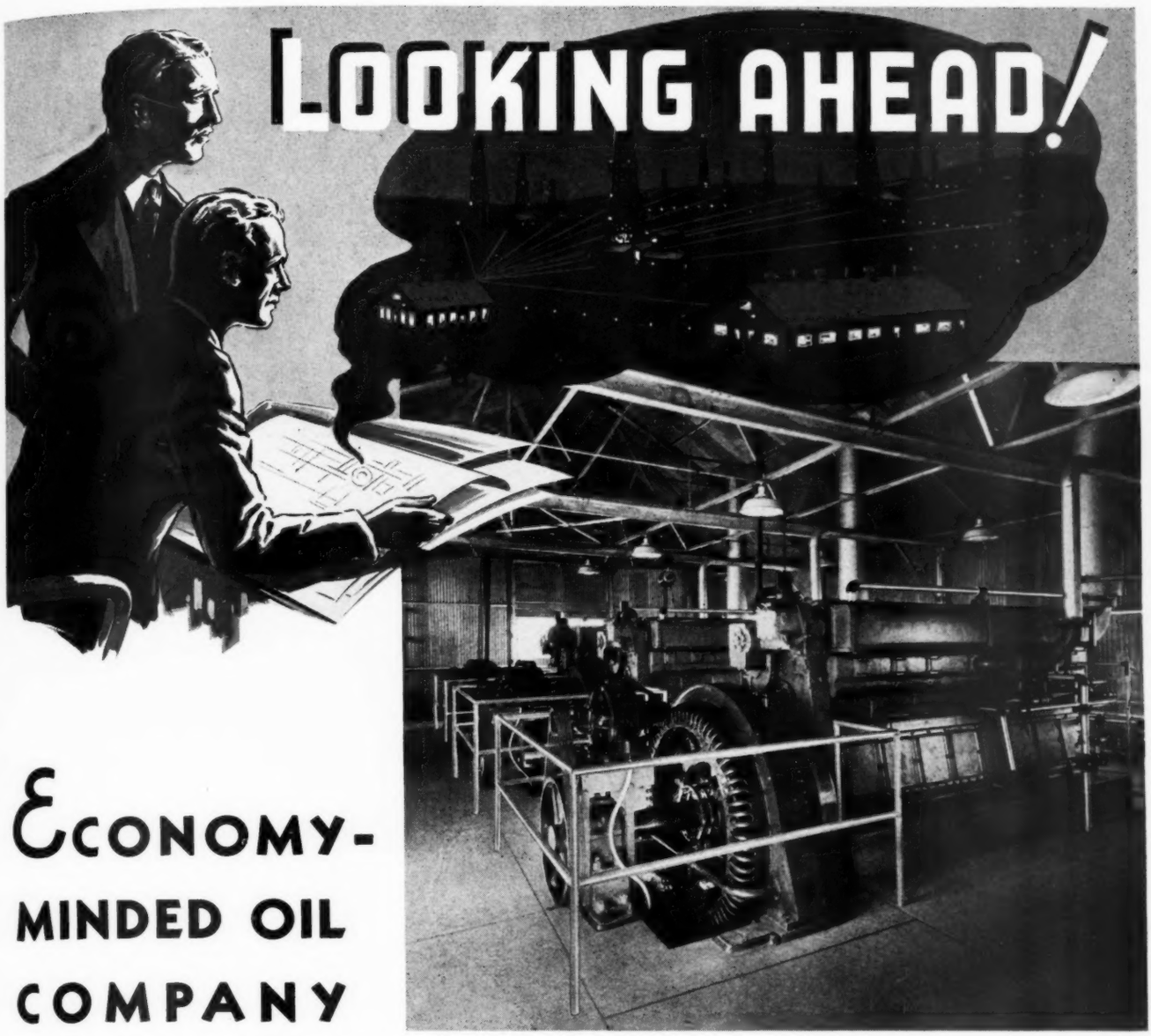
Fig. 7. Fifteen amperes removed one lb. of metal in 42 hours from this junk iron. One ampere would remove one lb. in 630 hours, or 13.9 lb. of metal per year



It has been possible to perform various experiments with this unit. One of the most interesting was to determine accurately the amount of chemical action produced by a unit current in a unit time in a solution of salts as exist in this drain ditch.

Fig. 7 shows two pieces of 2-in. junk pipe. The one on the left was the same size as the one on the right before it became the anode connection of the machine for a period of 42 hours. The current applied was 15 amp. and exactly one lb. of metal was removed. From this it is seen that in this drain ditch one amp. will remove approximately 14 lb. of metal a year, or 1400 lb. could be removed annually by a current of 100 amperes. This figure was checked on several other pieces of pipe at different current values and in each instance the amount of metal taken into solution was directly proportional to the current used.

This unit has proved to be very economical in its operation, as it consumes only 600 cu. ft. of gas per 24-hour day when running full-loaded, and oil at the rate of one quart a week. Only minor repairs have been necessary at a very small cost and not one leak has occurred on the 1200 ft. of 16-in. line since the machine was placed in operation.



ECONOMY-MINDED OIL COMPANY BUILDS POWERFUL GENERATING PLANT

Looking forward to the day when as many as 70 wells may be on the pump, E. H. Moore, Inc. has installed these three Type GN-8 Diesel-electric sets in the Fitts Pool, Okla. Each is rated 400 H. P. at 400 r. p. m. Additions or removals can be made by units.

The Moore properties are ideally grouped for the operation of a generating plant of this size. All the necessary current for the camp, the compressor station, and the wells is provided by this central plant. Convenient, reliable, economical!

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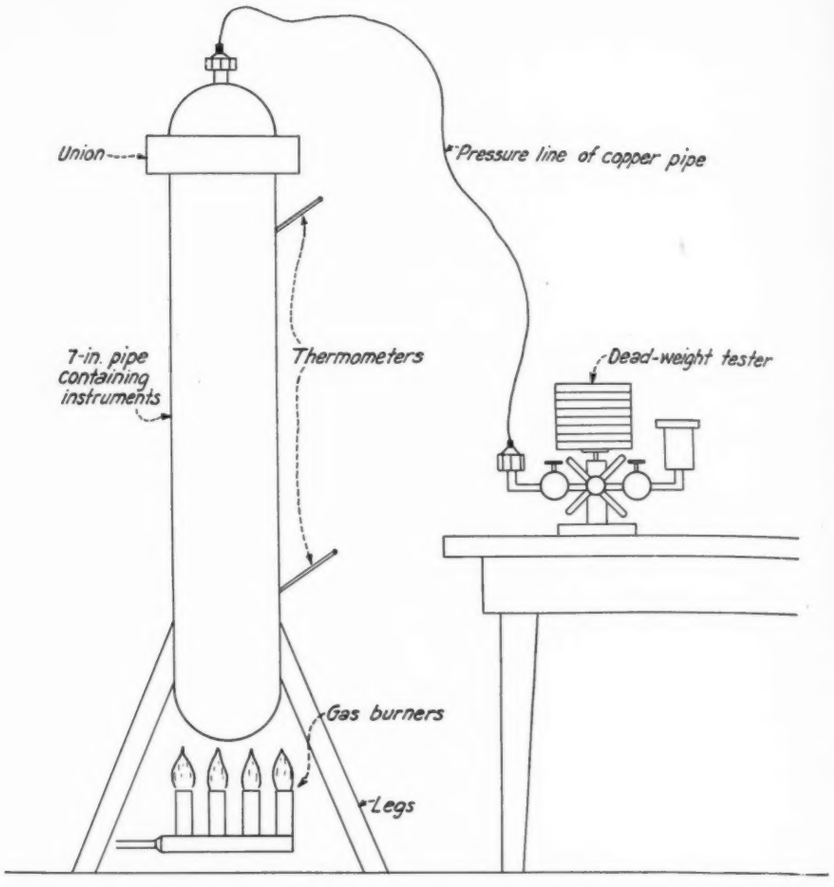
Apparatus devised for testing bottom-hole pressure bombs



By
A. S. PARKS*

Apparatus for Simultaneous Checking of Bottom-Hole Pressure Bombs

IN fields where bottom-hole pressures are checked at regular intervals, it is customary to run all instruments used in the pressure survey in the same well on the same day in order to check the accuracy of each bomb. Under ideal conditions, the pressure read from each instrument should be the same, but this rarely happens to be the case.

The manner in which each operator calibrates and runs his instrument, as well as the variation in dead-weight testers used in calibrating the different instruments, all go to make differences in the results obtained. Another factor that is somewhat uncertain is the possibility of a change in pressure within the well itself during the time required to run all instruments.

Accurate bottom-hole pressures have been imperative since the proration order for the Rodessa field has been in effect, because the daily well allowable is based partly on such pressure. To insure that all instruments used in making the survey are registering alike, those engaged in taking bottom-hole pressures in the field have set up an apparatus for calibrating all instruments simultaneously and under bottom-hole temperature conditions.

A short piece of 7-in. casing was fitted with legs and end caps, so as to stand upright with all the instruments suspended inside. The pipe is filled with water heated to bottom-hole temperature, the instruments are all loaded and put in the bath, the top cap put on the container, and pressure then is put on the entire system with a dead-weight tester as shown in the accompanying illustration. By holding the pressure constant for short periods at various levels, data are obtained from which complete calibration curves are plotted for all clock-equipped instruments.

The calibration curves thus obtained are used in reading the charts obtained in the key wells; so the only error possible for each instrument under these conditions is that due to mechanical errors in running the tests and reading the charts. This method has proven much more satisfactory than the running of all instruments in the same well for checking purposes.

*Parks Engineering Service, Houston, Texas.

Petroleum Emulsions and Their Chemical Resolution » » » »

By C. H. M. ROBERTS*

In its practical aspects the process of chemically resolving petroleum emulsions is simple provided one adheres to the fundamental principles upon which it is based

THE subject of petroleum emulsions and their resolution is one of considerable technical and economic importance to the oil industry. The study of petroleum emulsions embraces many sciences and their resolution by the use of chemicals is a highly developed and very specialized art. The purpose of this brief article is to sketch the broad outlines of the subject but without attempting to consider any portion in great detail.

All crude oils and brines contain, as normally present constituents, certain substances that possess the property of segregating, or adsorbing, at surfaces or interfaces. When oil and brine are produced together, as occurs in many wells, they become intimately mixed and, due to adsorption of the substances previously mentioned, the mixture becomes stabilized as an emulsion. It so happens that, in the vast majority of cases, the characteristics of the adsorbable materials are such that only dispersions of water in oil become stabilized as emulsions. In a relatively few instances, the reverse type of emulsion, i.e., oil in water, is formed, while in rare instances the characteristics of the adsorbable substances are such that both types of emulsions are formed. In such cases the resulting emulsion is called a dual emulsion, since it consists of both types. In the following discussion, it is the "normal" water in oil emulsion that will be considered, although much of the discussion will apply equally well to the other types.

Whatever the type of emulsion, it consists essentially of small drops of the dispersed phase, suspended in the continuous or external phase. At the interface between the two liquids there is a continuous and more or less resistant film of adsorbed material, which prevents contact between and coalescence of the droplets of the dispersed phase. It is the presence of this film that stabilizes the emulsion and it is the properties of the materials composing this film into which we must inquire in order to accomplish the resolution or separation of the emulsion by means of chemicals. It is necessary to determine the characteristics of the adsorbable materials in both phases, but, for the "normal" water in oil emulsions, it is usually the materials in the oil that are of most importance. For those who may wish to inquire further into this phase of the subject, reference is made to a theoretical discussion presented by the author some years ago[1].

From what has just been said, it will be apparent that the formation of emulsions is to be expected when crude oil and brine are produced together. Their intimate admixture is a normal consequence of the methods of production and their subsequent stabilization as an emulsion is an inherent property of the system. It is true that resistant emulsions are not always formed but this is due to variations in concentration and properties of the adsorbable materials in oils and not to any factor within the complete control of the producer. It is only when the characteristics of the liquids are such that stable emulsions are not easily formed that in production technique. In most instances, however, it is possible to decrease the severity of the emulsion problem by the use of good equipment and by its maintenance in perfect condition, since the character and severity of the agitation is an important factor in determining the sizes of the droplets of the dispersed phase and this, in turn, greatly influences the difficulties involved in resolving the emulsion.

To complicate the problem further, both in its scientific and practical aspects, the characteristics of an emulsion are changing continually, from the moment of its formation to the instant of its complete resolution[2]. This occurs because there are numerous types of adsorbable materials in a given oil and their rate of adsorption and permanence of location at the interface vary with the age of the emulsion. In addition, the concentrations of the diverse materials in an oil vary during the productive life of a well, depending upon the uniformity of the oil in the producing formation. These two factors, on the one hand, produce progressive changes in the properties of a given emulsion, depending upon its age and upon the character of handling to which it is subjected and, on the other hand, cause the production, from a given well, of emulsions whose properties differ as a function of the age of the well and percentage depletion of the sand. Thus it is seen that the emulsion problem presented by a given well depends upon many factors, including the physical conditions of production and handling, the properties of the liquids produced, and a time factor, involving both the age of the emulsion and the age of the well.

Another factor, which has not been discussed but is often of great practical importance, is the relative proportion of water and oil produced. It is well known that many wells that produce resistant emulsions for a time, clear up almost completely when the percentage water increases beyond a certain, but variable, limit. This arises from the fact that the dispersion characteristics of a given system of oil and water depend in part upon the proportions in which the two liquids are mixed. This subject has been discussed in full elsewhere[3] and will not be elaborated upon here. It suffices to say that, when the water production approaches or exceeds the oil production, it may be expected that the severity of the emulsion problem usually will diminish. That this does not always occur is, of course, well known and is due to the physical conditions of production and handling of the mixed liquids, and to the properties and compositions of the liquids themselves.

From what has been said, it will be realized that the formation and stabilization of emulsions is a very complex subject and to understand them involves many phases of scientific and practical knowledge. The resolution of petroleum emulsions is even more complex, since it involves not only an understanding of the factors that produce emulsion stability but also the knowledge of how to overcome the effectiveness of those factors, so as to cause resolution of the emulsion and its

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separation into pipe line oil and water. In addition, the process must be expressed in the simplest possible terms, so as to be suitable for practical and economical application on every lease or well.

The factors that determine the effectiveness of the treating compound in resolving a given emulsion are, broadly, the characteristics of the emulsion, the characteristics of the compound, the conditions of its application to the emulsion, and the conditions afforded for settling and separation of the water. These factors may be summarized briefly as, (1) the kind of emulsion, (2) the kind of chemical, (3) how they are put together, and (4) what happens afterward. Enough has been said previously concerning the characteristics of the emulsion.

The characteristics, which include both physical and chemical properties, of the chemical compound must be such as to enable it to nullify or destroy the effectiveness of the emulsifying constituents in the system, at the time and under the conditions existing when the compound is applied to the emulsion. These requirements mean, first, that the chemical, in the concentrations employed, must be miscible with the system, so that it can reach the vicinity of the water-oil interface and, second, that, having arrived there, it must be capable of accomplishing its purpose of nullifying the effectiveness of the stabilizing agents already there. The second requirement involves a time factor that depends upon the age of the emulsion when treatment is applied. The compound must be able to act suitably upon the materials present at the interface *at the time treatment is applied*, and the nature and stability of these materials depends upon the age of the emulsion. This necessary correlation, between conditions in the emulsion and the type of compound employed, explains why different compounds often are required according to whether treating is done in the well, on the flow line, in lease tanks, or on tank bottoms. It also explains why it is sometimes necessary to change compounds at appropriate intervals during the productive life of a well. Fortunately, in most instances changes in character of the emulsion, which necessitate changes in type of compound, occur very slowly and over long periods of time, so that, in general, few changes in compound are necessary during the life of a well.

Granted that there is available a compound ideally suited to destroy the stability of the emulsion in a given water-oil system, it still is necessary to employ suitable conditions of application of the treating agent if the best results are to be achieved. It is impossible to resolve an emulsion, even under the best of conditions, if the compound is totally unsuitable for that emulsion. It is equally impossible to perform a first class treating job, with a suitable compound, if the conditions of application are totally unsuitable. Among the conditions of application that are of maximum importance in determining the efficiency of treatment are: (1) the point of introduction of the chemical, (2) the degree and duration of agitation of the system, (3) the kind, amount, and strength of chemical solution employed, and (4), the temperature of treatment. The point of introduction of the chemical is important in relation to the progress of adsorption in the emulsion, hence it is usually more economical and more effective to introduce the chemical as soon as possible, provided this does not lead to excessive duration or degree of agitation. The character of agitation is of great importance in treating, and it must be neither too severe nor too prolonged. It must be remembered that agitation is the dynamic factor that produces dispersion of the water in the oil and that this is the condition precedent to stabilization as an emulsion. It seems paradoxical that agitation also should be employed in destroying the emulsion, yet this is a fact. The purpose of the agitation used for treating is to accelerate the diffusion of the chemical through the oil to the interface and to increase the number and intensity of impacts between neighboring water droplets. The agitation must be of sufficient intensity to cause impacts that lead to coalescence of the very small droplets, but must not be excessively vigorous, since this would cause a shattering of the drops into still smaller droplets. The agitation must be prolonged for a sufficient period of time to permit the chemical to reach the vicinity of the interfaces of all, or at least a large proportion, of the emulsion particles and prepare them for coalescence with other drops. It also must be prolonged until all, or a large proportion, of the small droplets have been coalesced to a sufficiently larger size so that they are ready to enter the last stage of the process.

The kind, amount, and strength of chemical solution is a factor of importance in treating, but is of less importance than formerly was the case, when the chemical was used, promiscuously, in water or oil or without dilution. In present practice, Tret-O-Lite, a treating compound in general use, usually is used without dilution, except for treating down the well, in which case solutions are necessary for physical reasons. In general, it is most desirable to employ the chemical "straight" or in solution in oil, although there are places where, due to the characteristics of the system, water solutions are preferable and give the best results. Where water solutions are so used, or where the chemical is employed for treating in the well, it is important that the fresh water employed be a soft water, or be first subjected to a suitable water-softening treatment. When the compound is used in solution, it is sometimes possible to improve treating results by mutually adjusting the strength of solution and amount of solution employed. This usually has to be done empirically, by trial on the lease.

The temperature of treatment is an important factor in determining the success of the process and is most far-reaching in its effects. It controls, among other things, the specific gravities of the water and oil, the viscosity of the oil, the activity of the adsorbable constituents in the system, and their permanence at the interface. Similarly, it affects the properties of the compound used and, finally, it controls the kinetic energy of the impacts caused by the agitation employed, besides altering the intensity of the agitation itself. In short, it is a factor that controls, in some degree, every property and characteristic of the system.

The last of the factors that determine the effectiveness of chemical agents in resolving emulsions comprises the conditions afforded for settling and separation of water. This stage in the treating process hardly is distinguishable at times from the agitation and mixing stage, which immediately precedes it, and is really a continuation of that stage, but under milder conditions of agitation. During this stage of the process, the coalescence of water drops proceeds continuously, under agitation sufficient to bring them into contact, but gentle enough to prevent their redispersion. In addition, the arrangement of the equipment is such that the incoming, partially coalesced, emulsion is caused to wash up through a body of water in the tank, the effect of which action is to assist materially in accelerating coalescence. The physical properties of the system that are of chief importance in aiding settling and separation of water are low oil viscosity and a large difference in specific gravity between the water and oil. The first property is subject to control by means of heat, the degree of heat required being sufficient to lower the viscosity to or below about 75 to 100 seconds Saybolt. In general, viscosities of this order of magnitude usually are sufficient to

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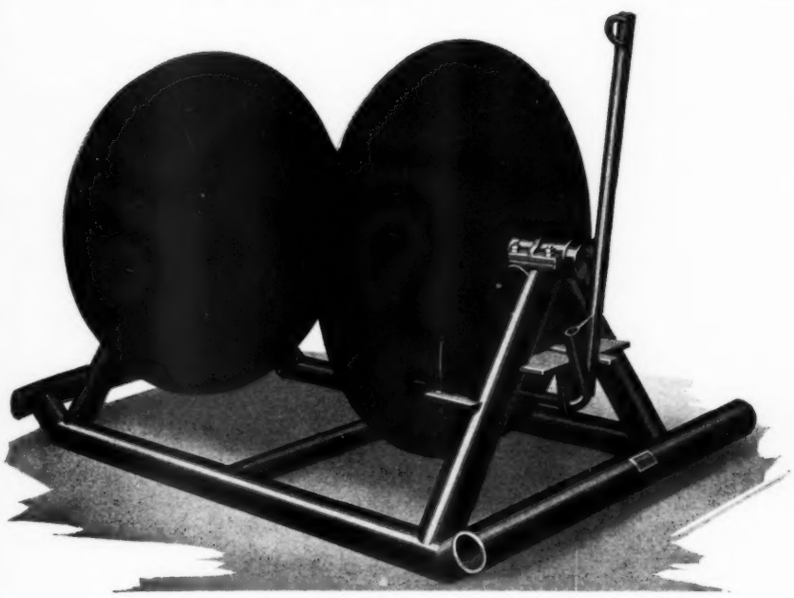

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afford favorable settling, although sometimes, due to higher temperature requirements for other reasons, the viscosity may be much less than this limit. Conversely, under favorable treating conditions, it is often possible to obtain rapid and efficient settling at temperatures corresponding to much higher viscosities.

The matter of gravity differential is one that, under ordinary production conditions, is not susceptible to control. The oil and water must be accepted as produced and the best possible results obtained with them. Some measure of control of gravity differential, however, can be exercised by application of the proper amount of heat. Both oil and water, of course, expand when heated and their specific gravities decrease; however, they do not usually expand equally, the rate at which the oil expands being dependent upon its composition and gravity. This means that the gravity differential, as a function of temperature, may increase, decrease, go through a maximum or a minimum, or remain unchanged. Thus it is frequently possible to obtain improved results by operating at the temperature giving the most favorable gravity differential. If this temperature is not compatible with that required for the most favorable viscosity, a compromise between the two values must be employed.

In addition to these factors of gravity differential and viscosity, an extremely important element in the stage of settling and separation of water lies in the selection and suitable equipment of the tanks employed for this purpose. It is understood, of course, that the typical treating plant operates continuously, the partially treated mixture being introduced into the tank near the bottom on one side, while separated water is drawn from the bottom on the other side and pipe line oil flows from the top into the stock tanks. Since fluid is continuously being fed into the tank, usually called the "gun barrel," it is obvious that there is an upward flow of oil in the tank, against which flow the coalesced water drops must settle. It is extremely important therefore that the size of the tank, and especially its diameter, be suitably chosen with reference to the volume of production to be treated, so that the vertical velocity will not be excessive. The limiting velocity, above which effective settling will not occur, depends upon the size of the water drops, the gravity differential, and the viscosity of the oil. It is apparent therefore that all these factors must be given due consideration in determining the conditions suitable for settling and separation of water.

From even this brief discussion of emulsions and their chemical resolution, it will be apparent that the subject, in its scientific aspects at least, is one of great complexity, each of whose factors must be considered in its relation to all other factors if success is to be achieved. In its practical aspects, however, the chemical resolution of emulsions is a process of great simplicity, provided only that one adheres faithfully to the fundamental principles upon which it is based.

The subject is a complex one but there is nothing mysterious about it. It is hoped that this discussion will serve a useful purpose in dispelling whatever elements of mystery may still cling to it and in pointing out at least some of the basic principles of the sciences and arts upon which it depends.

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[1]Roberts, J. Phys. Chem. **36**, 3081-3107 (1932).

[2]Roberts, *The Electric Dehydrator*, **5**, No. 2, April, 1935. (House Organ, Petroleum Rectifying Co.)

[3]Roberts, Twelfth Colloid Symposium Monograph, 111-130 (1935).

Alloy Refinery Castings Resist High Pressures and Temperatures

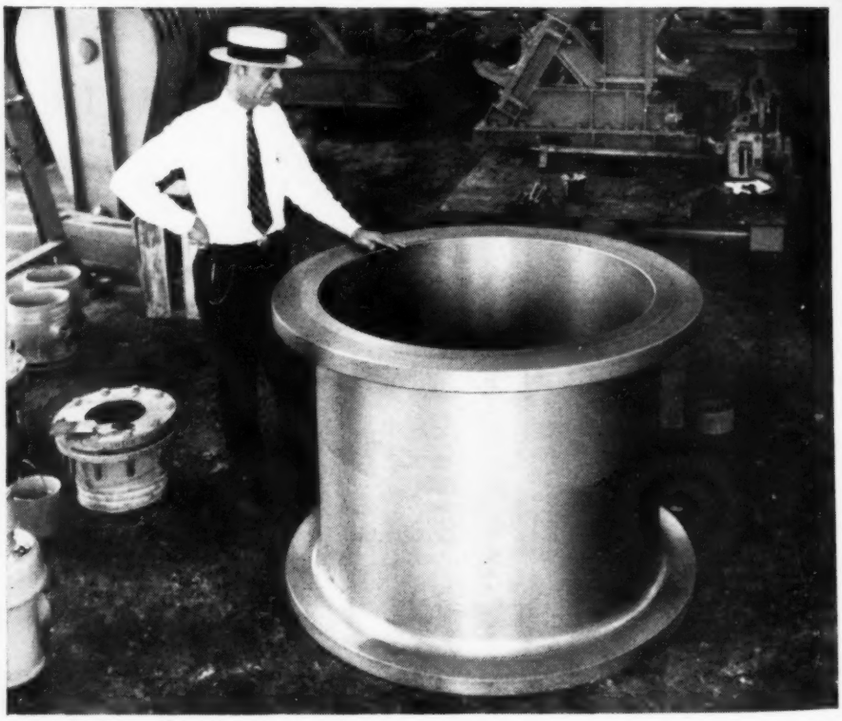
THE large casting shown in the accompanying illustration in a semi-finished condition is a vapor channel for a heat exchanger used by a large Texas refinery. Nickel-chromium molybdenum steel was used in its manufacture to resist the combined high pressures and temperatures. The casting was made by the Beaumont Iron Works Company, Beaumont, Texas, who specialize in the making of castings for the petroleum industry.

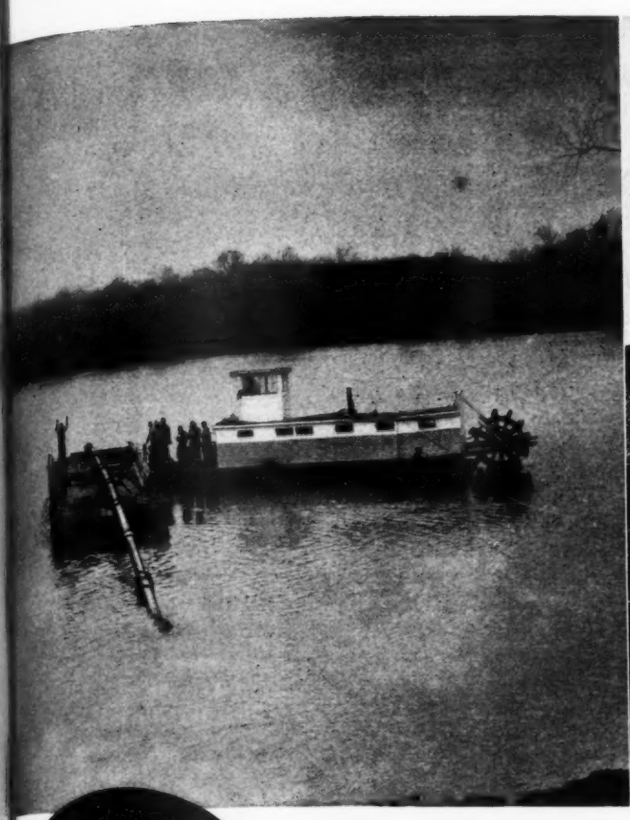
The average composition is as follows:

Carbon %	*Manganese %*	*Silicon %*	*Nickel %*	*Chromium %*	*Molybdenum %*
0.34	0.59	0.32	1.97	0.79	0.30

MECHANICAL PROPERTIES:

	Specification, Minimum	*Results*
Yield Point, p.s.i.	65,000	78,500
Tensile Strength, p.s.i.	100,000	104,700
Elongation in 2", Percent	18	20.5
Reduction of Area, Percent	30	45.5
Bend Test (°)	75	98





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Bleaching Clay « PART 2 »

By RAFAEL FUSSTEIG

Theory of Adsorption

SINCE the principal action of bleaching clay in the decoloration of oils is one of adsorption it may be of interest to consider some of the pertinent opinions investigators have advanced concerning this process. By adsorption in solution, the only type that will be considered here, is meant the increase in concentration of a dissolved substance in the layer of liquid bounding the solid surface, the so-called boundary layer. According to the studies of Freundlich, adsorption can mean a concentric change of a solution on its surface. It makes no difference whether this phenomenon occurs between the limit of a solution and atmosphere, or between the liquid phase, or whether it occurs between a liquid phase and a solid phase.

Gibbs, working from thermodynamic considerations, has evolved a law that can be expressed as follows: When dissolved matter changes the original surface tension of a solvent, the concentration of its surface will be changed, having in consequence a substance of quite another concentration in the remaining solution. The concentration of this solution will be changed in such a manner that surface tension declines to a minimum. When surface tension of a solvent is reduced by dissolved matter, the latter tends to collect on the surface of the solution, causing an increase of concentration on the surface layer of the solution.

By adding to the solution mentioned a certain volume of solid material, the surface tension of the limit of these two phases will be lowered as the concentration of the surface tension increases. In this instance, the concentration of the remaining solution decreases. This lowering of the concentration of the solution easily can be observed when the surface of the solid material is great enough. In other words, the solid material has adsorbed on its surface a certain amount of the dissolved compounds.

As a result of these observations, Freundlich has published a theory that quantitatively proves the dependence of adsorption upon the concentration of the solution and the amount of the adsorbent. He has expressed this dependence in an equation, and it is now generally recognized that the removal of various undesirable constituents from the oil by adsorption follows this equation, the so-called adsorption isotherm of Freundlich. This equation is mathematically expressed as follows:

$$\frac{x}{m} = K C^p$$

where:

x = units of impurities removed
m = quantity of adsorbent used
C = equilibrium concentration of the impurities in the oil
K and p = constants, depending on the nature of the adsorbent substances adsorbed, and the solvent

By plotting the amounts adsorbed against equilibrium concentrations a curve of the general type represented in Fig. 1 is obtained.

This equation can be converted into the logarithmic forms:

$$\log \frac{x}{m} = \log K + p \log C$$

The logarithmic equation shows that the plotting of the value of $\log \frac{x}{m}$ against log C gives a straight line with a slope p, intersecting the Y-axis at a point corresponding to log K as shown in Fig. 2. It also can be seen that a slight error in color readings does not appreciably affect the lower part of this curve. The equation indicates that fractional addition of adsorbents to the oil should be advantageous, and refining of the oil by percolation through a column of adsorbent material should give better utilization of the adsorbent than direct contacting of the adsorbent with oil, since the percolation is equivalent to applying the adsorbent in an infinite number of stages.

The same equation indicates further that it is preferable to treat two oils of different color separately and then mix them rather than to mix them first and then treat them. It also indicates that the treatment of oils diluted with some inert, colorless oil would not be comparable to the treatment of the diluted oils, and further, that partial removal of the impurities from an oil should render the oil more resistant to further treatment. The equation can be applied advantageously for the evaluation of the relative efficiencies of adsorbents. As constants K and p depend both on the properties of the adsorbent and the oil, the relative efficiencies of adsorbents can be compared only by investigating their effects on the same oils, since the impurities in lighter and heavier petroleum distillates, or in distillates from varied sources, are not uniform.

Langmuir[1] has proposed an equation, which, assuming a simple type of adsorption, can be deduced as follows:

$$G = \frac{r c}{B + \frac{r c}{Z}}$$

where:

G = adsorbed quantity
Z = limits of adsorption
r and B = constants

The equation of Langmuir gives more of the curve than does the adsorption isotherm of Freundlich, but even though these equations apply in some instances there are a number of instances in which they do not.

Equilibrium is attained rapidly in most adsorptions. In instances where equilibrium is reached slowly it seems probable that the adsorptive reaction is

Fig. 1

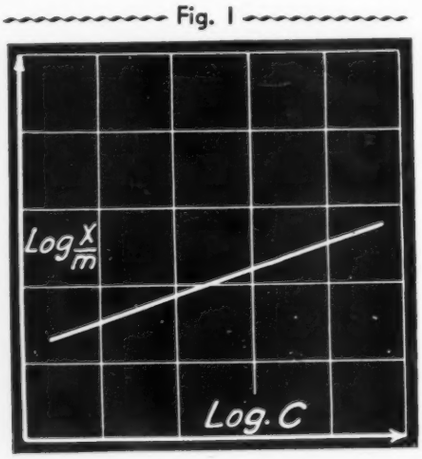
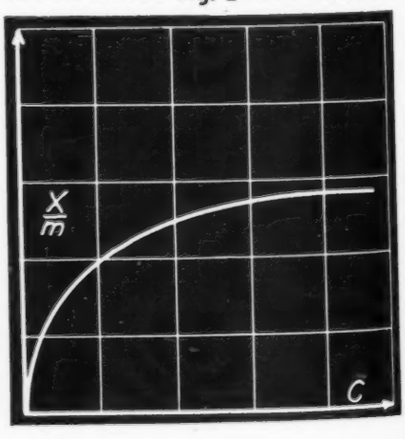


Fig. 2



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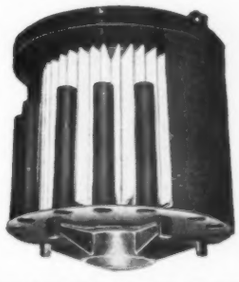

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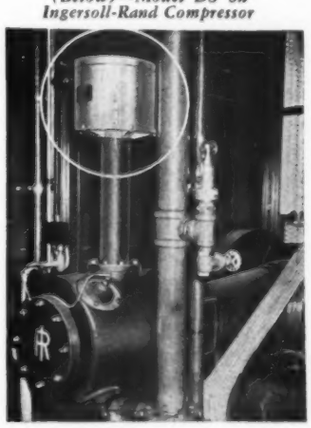

not simple. In a number of such cases it has been found that the adsorption is followed by a chemical reaction. Most of the evidence seems to indicate that the adsorption process is an equilibrium reaction, thus necessitating the presence of some unadsorbed molecules of solute in solution even though in instances such as the adsorption of certain dyes the dye appears to be completely removed. Equilibrium considerations do not indicate complete adsorption as a limiting case; nevertheless the adsorption curve shows a limiting value. One explanation of this limiting value, other than a limiting value by reason of complete adsorption, has been offered by Langmuir.

Langmuir represents the adsorbent as a crystal lattice in the interior of which all valences are saturated, while on the surface there are regularly-distributed unsaturated valences. It is these unsaturated valences that presumably are responsible for the adsorption. Molecules penetrating the sphere of attraction of these unsaturated valences are adsorbed but they tend to escape due to their kinetic energy, which acts in an opposite direction.

Haber[2] supposes that the adsorption is a loose chemical combination between the adsorbent and the adsorptive. According to the opinion of this great investigator, the valences of the atoms on the surface of the adsorbent are not completely saturated, and therefore they go into reaction with the adsorptive molecule. Opposed to the theories of Haber and Langmuir, Eucken[3] contends that no saturation occurs in the adsorption process. He asserts that a fall of potential obtains on the surface of the adsorbent, this fall being able to attract an adsorptive molecule on the point of the surface of the adsorbent. Lorenz and Lande[4] consider the adsorption power as purely electrical. According to their opinions, adsorption is a result of the action of the molecule fields.

Gurwitch also has studied this phenomenon of adsorption and has explained it as follows: In event that an adsorbent comes into contact with a solution, it attracts on its surface both the molecules of the dissolved substance and those of the solvent. Because of this attraction, a covering of condensed molecules is formed around the adsorbent particle. The proportion of the molecules of the dissolved substance to the solvent adsorbed in the cover can be determined: (1) by the proportions of both molecules in the solution; (2) by the power with which both molecules are attracted by the adsorbent. Therefore, when permitting the same adsorbent to act on solutions of equal concentration and of different adsorptives in the same solvent, that adsorptive will be adsorbed the strongest whose adsorption power to the adsorber is the greatest. On the other hand, when taking into consideration solutions of equal concentration of the same adsorptive in the different solvents, that adsorptive will be adsorbed the strongest whose attraction to the corresponding adsorbent is least.

The writer has studied this problem at length, and, according to his observations, the kind of adsorptive, i.e., the sort of substance dissolved in the solution, plays a most important part in adsorption processes. To prove the correctness of these theoretical considerations the writer has carried out the bleaching process of a paraffin wax distillate and a vegetable oil. It has been found that the former contained coloring matter in the crystalloidal form, whereas the latter showed the coloring matter in the colloidal mucilages and albumins, these being separated by the decolorizing process as flocculent precipitates.

If we now inspect the behavior of the previously-mentioned oils we are forced to the conclusion that two processes occur during decoloration of oils: an adsorption of the adsorptive, and a separation of the adsorptive as flocculents. In the first instance the mircroscopic channels will be filled with certain coloring matter, and in the second instance other coloring matter will be precipitated on the surface of the adsorbent. From this the interior and exterior adsorption phenomena occur in the bleaching processes; furthermore, the writer very often has observed in his practice that the use of the same bleaching clay in the refining of lubricating oils of different origins, did not result in the same degree of decoloration. Each oil requires a separate kind of bleaching clay, i.e., a bleaching clay may cause a high bleaching activity with a certain oil, but may not be able to decolorize another oil.

The reason for this is that the microscopic channels of clays do not exist in the same width and length. As indicated, the dissolved matter to be adsorbed from an oil by the adsorbent can exist in crystalloidal and colloidal form; however, they can exist as a single compound, both mixed in certain proportion. The presence of colloidal and crystalloidal compounds, however, make impossible a favorable bleaching with only one kind of bleaching clay. This behavior leads to decoloration of oils in part only. In addition to this phenomenon, the crystalloidal compounds consist of several constituents of different crystalloidal structure. This is the reason that one bleaching clay is not always able to decolorize entirely the oils, and that many refiners are forced to employ various mixtures of bleaching clay.

Rakusin[5] shows that there is a relation between adsorption and chemical reactions. This opinion must be refuted because it is possible to extract unchanged coloring matters from a used bleaching clay by means of 95 percent ethyl alcohol. Were the theory of Rakusin correct it would be impossible to extract coloring matters in the unchanged state. Of course, the regenerated clay could not present the same adsorption power that it had in the virgin state. The reason for this, the writer believes that mechanical impurities, certain colloidal compounds of tar and resin-like nature, have been precipitated on the surface of the particles of bleaching clay.

It is true that certain chemical reactions accompany the decolorizing process, but these are not a result of the adsorption processes. Bleaching clays often contain considerable amounts of carbonates and alkaline earths that, during decoloration, go into reaction with certain compounds and form soaps of calcium and magnesium. The writer has examined various clays of this type and could establish a part neutralization of the acids in the oil, but an exact and complete neutralization could not be established by these investigations. Clays contain carbonates that are transformed into sulphates by the influence of strong acid, and it is assumed that the reason for incomplete neutralization lies in the fact that the chemical attack of the sulphuric acid on the oil produces sulphurous acids that are not strong enough to dissolve the carbonates. This hypothesis is confirmed by the fact that in all tests made only a very small part of acid could not be eliminated. The inconveniences here mentioned caused the writer to continue his investigations on basic clays, and these have proved the existence of two types of basic bleaching clays:

1. Bleaching clay whose basic reaction is caused by the interior structure of the clay, i.e., such clay presents a silicate one of whose components is a carbonate. When using such clay on an acid oil, reaction between the carbonates and the acid occurs, resulting in the destruction of the microscopic structure of treated clay.

2. Bleaching clay whose microscopic structure was filled by carbonates, leached through many thousands of years by the degradation under atmospheric influences; for example, Carlonit-clay may be mentioned here, a bleaching clay coming from the vol-

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The photograph shows Alma Oil Company's "Kloh No. 2" in Ector County, Texas—drilled by Richmond Drilling Company of Big Spring, Texas. The men, left to right, are: Frank Smith, floor hand; J. M. King, derrick man; F. E. Eppler, engine man; Herbert Miller, farm boss, Alma Oil Co.; O. K. Hostetter, driller; Percy Bosworth, contractor, Richmond Drilling Co.; Orville Brasuel, visitor; Harry Reigle, contractor, Richmond Drilling Co.; H. R. Cutlip, Union Wire Rope Corp.

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canic region of the mineral water springs of Carlsbad, whose carbonates were leached by the action of hot springs during the volcanic processes of prehistoric times. This leaching process was carried out in such a manner that a thin layer of carbonates remained on the inside wall of the microscopic structure.

This thin layer of carbonates causes a simultaneous adsorption and neutralization of acid crystalloidal asphalts and tars. Considering this process it is easy to understand that complete adsorption and neutralization depend to a large extent not only upon the microscopic structure of the adsorbent but also upon the composition of its interior surfaces.

Sometimes a darkening of bleaching clay can be observed following the decolorizing process. The reason for this is the polymerization of certain unsaturated hydrocarbons, caused by a catalytic action of certain salts of iron and aluminum. Rideal and Tomas[6] found the activity of bleaching clays in the action of certain oxidation catalysts. In order to control the correctness of this theory the writer has used a fuller's earth found near Igualada, Spain. This earth, containing 8.5 percent iron oxide, can partly decolorize oils and paraffin waxes. After removing a certain amount of this iron oxide, the adsorption power of this earth disappeared entirely, but when submitted to an artificial activation in such a manner that the iron oxide remained unattacked the earth presented a double decolorizing property.

To prove the correctness of his observations the writer has carried out bleaching experiments using the bleaching clay of Igualada, and a fuller's earth without any iron oxide content. Coloring matter was extracted by means of a solvent and then submitted to an analysis. It has been stated that the coloring matter is composed of higher molecular hydrocarbons; however, the two higher molecular hydrocarbons present were found to differ in their chemical composition, the coloring matter of the Igualada clay presenting a greater amount of oxygen than that of the fuller's earth. According to the writer's opinion the iron oxide, Fe_3O_4, is split up in the field of activity of the adsorption surface into ferrous oxide and active oxygen, this oxygen having bound the coloring matter, which presented in the new form a more adsorbable coloring matter than in the former state.

Traces of aluminium chloride in the artificially-activated clay also plays an important part in the polymerization of hydrocarbons on the adsorption surface of clays. As is known, when gasoline vapors are passed through the fuller's earth or other proper clays, some of the hydrocarbons are polymerized to higher-boiling compounds that condense at the temperature of the gasoline vapors. Hydrocarbons belonging to the diolefine group are generally considered to be those that are most readily polymerized by bleaching clays, but it is of great importance to use a proper bleaching clay, i.e., a clay containing components able to carry out a proper polymerization.

In passing gasoline vapors through activated earth, the diolefine hydrocarbons are polymerized to higher-boiling compounds, and the first time the gasoline seems to be perfectly decolorized; however, after a longer time, the gasoline becomes a yellow color, and darker and darker. The cause of this phenomenon is the aluminium chloride in the activated bleaching clay. According to the writer's opinion, certain hydrocarbons of gasoline, when brought into contact with an activated earth, due to the action of aluminium chloride, form certain unknown higher unsaturated hydrocarbons that are soluble in gasoline and cause the formation of gums. The compound in this instance acts as a catalyst. The process takes place first slowly, and increases with the further formation of molecules of the catalyst.

This theory has been practically established by investigations, and it may be explained as follows: the common action of the bleaching clay and aluminium chloride on unsaturated hydrocarbons causes the formation of certain unknown active higher unsaturated hydrocarbons, being able to react in such manner that it combines in the first phase two or more molecules of unsaturated, cyclic, and aromatic hydrocarbons. In the second phase the polymerized compounds change their interior structure, splitting up the molecules that act as a catalyst and form a new molecule of the same catalyst. This leads to a rapid lowering of the antiknock value. These phenomena, which occur in a limpid gasoline, result in a self-catalyst. That is why refiners prefer the use of natural bleaching clays in the refining of cracked gasolines.

The adsorption of coloring matter by an adsorbent does not occur immediately but requires at least ten minutes. The bleaching effect will not be altered unless duration of the action exceeds 30 minutes; however, when it is prolonged beyond 30 minutes, the bleaching effect decreases. According to the writer's observation, the effects are as follows:

Duration of mixing	*Adsorption effect*
3 minutes	50 percent
4 minutes	55 percent
5 minutes	65 percent
6 minutes	85 percent
7 minutes	95 percent
10 minutes	100 percent
15 minutes	100 percent
20 minutes	100 percent
30 minutes	99 percent
60 minutes	85 percent
90 minutes	82 percent

It can be seen that the long duration of action displaces the equilibrium to the detriment of the bleaching effect; moreover, the long duration of the action increases considerably the acid value of the oil, especially in the case when the artificially-activated earth contains high quantities of water. The influence of temperature on adsorption usually is very small. In most instances the adsorption is sometimes greater at lower temperatures and smaller at higher temperatures. It might be noted here that boundary tension usually decreases with the rising temperature.

The adsorption effect can be determined by means of wetting heat. Gurwitsch[7] devised a series of liquids, comparing them with two adsorbents such as floridin and charcoal. According to these determinations the unsaturated hydrocarbons come first, then come the compounds of oxygen and nitrogen, these compounds having the tendency to be transformed into compounds with three or five valences. Saturated and naphthenic hydrocarbons show a smaller wetting heat. Aromatic hydrocarbons may be placed between the unsaturated and naphthenic hydrocarbons. Of course, the greater the complexity of the molecular structure the stronger the adsorption. Viewing the adsorption process in the light of the above we are forced to the conclusion that the choice of a proper bleaching clay, especially of a proper mixture of clays, plays a very important part. Crude oils contain groups of harmful matter: colloidal compounds of resin-like nature, and coloring matters of various crystalloidal structure; moreover, the oils also contain certain amounts of oxygen, nitrogen, and sulphur compounds bound with various hydrocarbons; therefore, a favorable adsorption process requires bleaching clays of the proper microscopic structure, as well as the proper chemical composition for each type of the dissolved impurities that are to be adsorbed from the oil.

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The mud pump is driven by a Ford V-8 motor mounted on the pump

By
WALLACE
A.
SAWDON
Petroleum Engineer,
Los Angeles

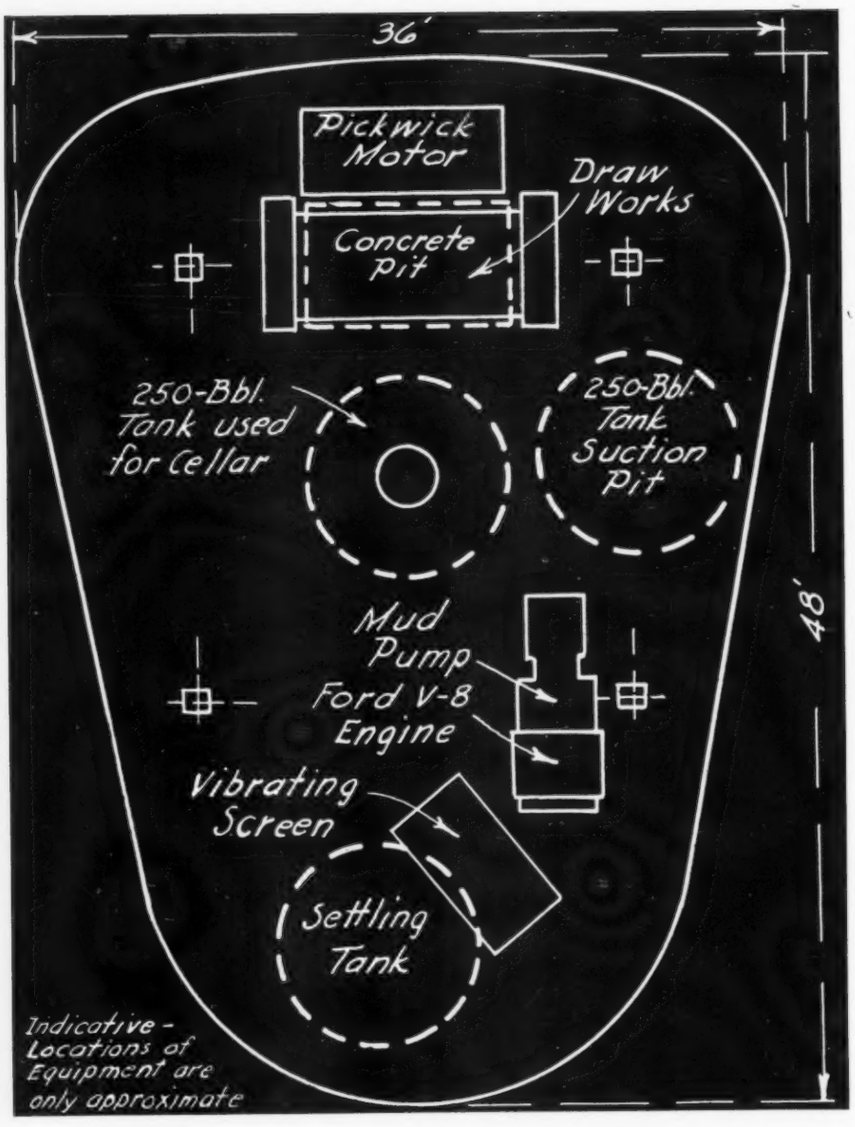
Only One-Thirtieth of An Acre

Believe it or not, a 4000-ft. well is being drilled on this diminutive tract—probably the smallest oil lease in the world. The operators were compelled to depart from the orthodox type and layout of drilling equipment.

DRILLING a well on what is probably the smallest lease in the world has required ingenuity in design and arrangement of equipment. The location is on a parkway island in the intersection of two streets at the top of Signal Hill, California. Although the derrick is not so close to other derricks as in many other town lot areas such as at Long Beach and other fields, the operations are confined to an area that leaves little room for convenience. The well is being drilled by Bass and Goodnight and present plans are to complete it in the upper productive zone at a depth of approximately 4000 feet.

As shown in the accompanying sketch, the lease is 48 ft. at its greatest length and 36 ft. at its greatest width. The shape of the lease adds to the inconvenience of operation and no storage space is available for any material or equipment. Drill pipe and casing must be hauled to the site only as needed and unloaded from truck when ready for use. The derrick is 80 ft. high and this allows only for the use of doubles.

Rigging up to drill a lease at the intersection of two streets on the top of Signal Hill, California



Showing the shape and dimensions of the lease, as well as the location of various equipment

The derrick base is 20 ft. square. The drawworks and rotary table are powered by an engine taken from a Pickwick bus. The engine has three speeds forward and one reverse with all controls conveniently placed at the driller's position. The 12 by 6¾ by 12 mud pump is driven by a Ford V-8 motor mounted above it, as shown in the accompanying sketch.

The mud passes through a vibrating screen and then through four ft. of ditch to the suction pit. Mud storage is provided by two 250-bbl. tanks and a concrete pit below the drawworks. One of the tanks serves as the suction pit and the other as the cellar, both being below the derrick floor. Settlings from the vibrating screen go to another 250-bbl. tank below ground, and this tank is expected to take care of all settlings during the drilling of the well without having to be cleaned out.

The necessity for keeping the well within definite limits throughout its entire course below ground is self-evident. Accurate measurements of both direction and inclination therefore are being made and, in order to eliminate coring out of the hole after each survey reading is taken, a small photo-record single-shot instrument is being used with retractable wire-line coring equipment.

Compressibility of Gases Determined by New Method

A NEW method of determining compressibility of gases has been developed by the U. S. Bureau of Mines, Department of the Interior, in the laboratory at the Amarillo, Texas, Helium Plant, which is operated under the Bureau's Petroleum and Natural Gas Division.

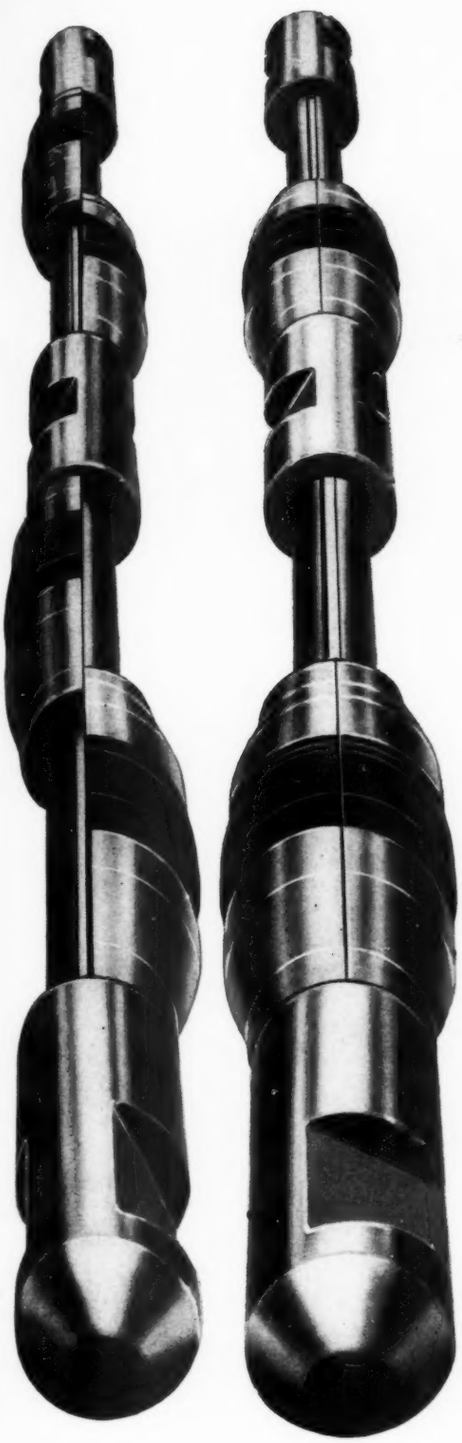
Customary methods of determining pressure-volume-temperature relations for gases require measurements of the volume of a constant mass of gas. Experimentally, it is much easier to measure pressures than it is to measure volumes with requisite precision, especially when the pressures are high and the associated volumes are small. The new method, devised by E. S. Burnett of the Bureau's staff, eliminates the necessity of making any volume measurements and permits calculation of the relations from observations of pressures and temperatures only.

In the 17th century the Irish scientist Robert Boyle, son of the Earl of Cork, announced that at constant temperature the volume of a gas varies inversely as the absolute pressure, and in the 18th century J. A. C. Charles, a French mathematician and physicist, stated that at constant pressure the volume of a gas varies directly as the absolute temperature. Since their announcement, these two "gas laws," and combinations of them, have served admirably in many engineering and industrial computations dealing with real gases, although these laws apply strictly only to a hypothetical "ideal gas." Amagat studied deviation of real gases from the gas laws as early as 1878, and since then it has been known that no real gas follows these laws exactly.

In earlier years deviations from the gas laws were of scientific rather than practical interest, but as industrial processes have become more complex and gases have been handled at higher pressures and wider ranges of temperatures, it has been necessary for engineers and industrialists to take account of the actual pressure-volume-temperature relations as determined by experiments rather than those indicated by the laws of an ideal gas.

As the method developed by the Bureau facilitates experimental determination of the actual compressibility of a gas, it will be helpful in many problems.

The new method has been described by E. S. Burnett in a paper, "Compressibility Determinations Without Volume Measurements," delivered before the American Society of Mechanical Engineers and published by the Society in the December, 1936, issue of the Journal of Applied Mechanics.



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Abstracts of A. A. P. G. Papers, 22nd Annual Meeting, Los Angeles, March, 1937

In this section are presented abstracts of only some of the many interesting papers on the program

Discovery Rates in Oil Findings

By WALLACE PRATT

A STATISTICAL review of oil field discoveries by periods, the progressive accumulation of petroleum reserves, and the classification of discoveries according to method by which discovery was made indicate a decreased discovery rate in recent years. Possible explanations for this decreased rate are discussed.

The Future of Exploration for Petroleum

By E. De GOLYER

PROSPECTING for new sources of supply is a part of the ordinary going business of the oil industry to an extent not true for any other mineral industry.

The art of prospecting for petroleum has been developed to a high degree of perfection but it has developed naturally as an outgrowth of the production department. Functionally, no branch of the entire industry is more important than the exploratory branch and it should be established as a department as independent as refining. This is true even for the drilling of exploratory wells.

Some of the advantages that should follow such form of organization are: more effective results following the placing of definite responsibility; the development of cost accounting for oil finding; and the development of definite drilling equipment and technique for exploration as different from the existing exploitation technique and equipment.

Motion Picture Presentation of Reflected Wave Pattern from Various Geological Structures

By FRANK RIEBER

THE problem of exploring for many interesting anomalies by the reflection method resolves itself into the problem of deciphering the patterns of reflected waves which return to the surface. The complexity of these patterns is directly related to certain types of structural elements and arrangements. Geologists who expect to make use of geophysical methods should familiarize themselves with the classes of structure that return patterns easy to solve, and also with classes of structure returning complex and difficult patterns. The wave patterns from various simplified and typical structures have, accordingly, been computed mathematically, and verified by strobograph pictures taken on model structures. The results of this investigation are presented in the form of an animated diagram, from which the relation of structures to their emerging wave patterns may be clearly seen. Simple rules are given for classifying structures in accordance with the difficulty of interpreting these wave patterns.

The Interpretation of Geophysical Data

By L. W. BLAU

GEOPHYSICAL data result from measurements of physical properties. The geophysicist postulates certain possible physical causes of the observed effects. The geologist reasons from observed geologic effects to geologic causes. The difficulties confronting the interpretation of physical effects as reflected in geophysical data in terms of geologic causes are pointed out. The author takes the position that geophysical data must be worked up independently. A competent geophysicist-geologist may combine geophysical and geologic information in the preparation of a report that will then, and only when this procedure is followed, include all present knowledge of the area under investigation.

Variation of Oil in the Gulf Coast

By DONALD C. BARTON

COMPARISON of the A.P.I. gravity and percentage content respectively of the crude oils of Miocene, Oligocene, and Eocene Gulf Coast crude oils from depths of 3000 to 5000 ft. with the oils of corresponding age from depths of 5000 to 7000 ft. shows that the A.P.I. gravity of the fractions and the percentage content of the lower boiling fractions tend to increase with depth and age. The base of both the lower and the higher boiling fractions tends to change with increasing depth and age from naphthenic to intermediate, and almost to paraffinic. In order of similarity, those age-depth groups of crude oils are arranged: Shallower Miocene, Shallower Oligocene, Deeper Miocene, Shallower Eocene, Deeper Oligocene, Deeper Eocene.

That variation of the Gulf Coast crude is consistent with transformation under the effects of time and some factor or factors proportional to depth below the surface but is inconsistent with alteration under the effects of time and some factor or factors proportional to nearness to the surface. The theory of evolution of the Gulf Coast crude oils from heavy naphthenic ancestral oils under the effects of time and some depth factor or factors therefore still is advocated. The evolution consists in, (a) decrease of the specific gravity of all but the lowest boiling fractions, (b) increase in percentage content of the lower boiling fractions, and (c) transformation of the base from naphthenic toward and almost to paraffinic. Cracking cannot be the main reaction in the evolution. Methanation possibly plus cracking is regarded as the most plausible explanation of the evolution.

This law of the variation of crude oil is only one of many; and occurrences of one type do not preclude the existence of other types.

Laboratory Orientation of Well Cores by Their Magnetic Polarity

By E. D. LYNTON

A PRACTICAL laboratory method of orienting well cores by their magnetic polarity was first developed by the Standard Oil Company of California's Research Department early in 1928. The procedure is designed to determine the original orientation in the ground of cores obtained in the ordinary rotary system of oil well drilling. This is accomplished by identifying the north and south sides of a core, after it has been brought to the surface, through residual magnetic polarity in the heavy minerals of the rock. The writer describes the theory and the various steps in developing this idea from the original experimental machine to the commercial one, which is self-recording by photographing the deflections of a light beam.

In conjunction with this magnetic core orienter there has been developed a deviation corrector. Directions of dip obtained from samples cored from crooked holes were worked out as apparent dips and strikes. An instrument, known as a deviation corrector, has been designed to correct rapidly the apparent dip to the true dip, whenever the direction and degree of dip of the hole at the depth from which the core came are known. The instrument and mathematical computations are fully described in this paper.

Latest Developments in Aerial Photographic Mapping

By W. L. COZZENS

AERIAL photographic mapping is now worthy of the name Photogrammetry. The latest developments in this art are discussed and illustrated. They include new single-lens and multi-lens cameras; tolerances in mosaics with relation to ground control; the templet method of radial control; overlay sheets for line map locations; contour maps produced mechanically with the Stereoplanigraph; and the development and use of the Solar Navigator.

The Importance of Geological Data in the Acidizing of Wells

By P. E. FITZGERALD and W. WRAY LOVE

THE most important geological factors that affect acidizing are the chemical composition of the producing formation, porosity and permeability, stratigraphy, structure, and physical characteristics of the producing formation.

The effect of each of these factors on the results of chemical well treating is discussed, and means of avoiding certain difficulties that may arise because of impurities in the formation are mentioned.

Interrelationship of Geology and Geophysics

By O. L. BRACE

GEOPHYSICS has advanced to such an important place in the field of structural prospecting that there is a tendency, in some quarters, to relegate the geologist to a position of secondary importance in this field. Geophysics is here regarded as purely a new and complex means of reading strike and dip and, as such, is to be classed as an additional geologic tool.

Geology serves as an indispensable guide to every step of geophysical activity, and without such guidance the geophysicist cannot hope to reach his objective. Lack of coördination between the two technical branches has led, in the past, to much misinterpretation of geophysics, and continued future success will depend upon a greater degree of coöperation in preparing the background for geophysical prospecting and in interpreting the results obtained by such methods.

The Placedo Field of Victoria County, Texas, in Its Relationship to Gulf Coast Stratigraphy

By KENNETH DALE OWEN

THE Placedo Field is of interest to geologists in that it is typical of the structural and sedimentary conditions under which large reserves of oil have accumulated in the lower Gulf Coast of Texas.

The structure of the field is anticlinal in nature and is related to or superimposed on a much stronger regional feature that from deepest well control available to date expresses itself as a strong ridge or anticline. It is quite possible that at considerably greater depths the regional feature may involve faulting.

The oil has accumulated in two types of sand reservoirs: first, the 4700-ft. oil zone, which is found in a fairly uniformly developed intercommunicating sand series with common gas-oil and oil-water contacts in which the folding provides the structural trap; and, second, a series of deeper flank sands, erratic in development and lensing abruptly into shales and thus providing individual closures with each having its own critical gas and fluid levels.

From a rather casual consideration of the Placedo Field as a structural entity, the writer enters into a discussion of the stratigraphy of the area. Unfortunately, early geologic exploration was necessarily confined to surface outcrops. Now, in structurally negative areas of the earth's crust, where sedimentation has been active and progressive, down-warping of geosynclinal magnitude has persisted throughout long periods of time; a study of the surface outcrops that fringe the basin, regardless of how carefully the study is pursued, cannot and has not to date set up the true stratigraphic relationships that exist in the basin.

As a result of, first, deeper drilling and thus the availability of more section for study, second, refinement in micropaleontology and petrography and, third, the introduction of more accurate logging effected by extensive coring practice and electrical surveys, it has become possible actually to establish section and thus delimit true formational boundaries out in the basin where sedimentation has been more or less continuous and the complete depositional sequence has been preserved. By means of a series of dip sections graphically portrayed by Schlumberger and well logs bearing pertinent faunal markers, it has remained for economic endeavor to make available to pure geologic science the opportunity to study section in its fullest development. The writer then by means of a series of geologic cross-sections proceeds to outline some of the broader stratigraphic relationships that have become apparent, and in closing emphasizes the similarity of the depositional cycles for the major transgressions in the sediments lying between the fossiliferous Vicksburg and the base of the "Oakville."

Cheneyville Oil Field, Rapides Parish, Louisiana, and Its Relation to the Areas of Mother Salt Deposition

By GEORGE S. BUCHANAN

PART I of this paper deals with the means of discovery and the development to date of the first and only deep-seated dome in Louisiana, which is producing from the Cockfield formation. This paper is accompanied by original seismic reflection map, subsurface map, and cross section based on Schlumberger surveys. Part II discusses the possible relationship of this salt dome to the interior salt domes of Louisiana in connection with the Gulf Coast domes of that state, and also outlines the possible area of mother salt depositions and fixes the possible age for the mother salt deposition as being younger than Permian but older that Commanchean. It also postulates the extent and nature of a desiccated ancestral Gulf of Mexico.

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TYPE	FROM	TO	FOOTAGE	RECOVERED	FORMATION
REED KOR-KING	3415	-21	6 ft.	5 ft.	Lime-Anhy., Shale
"	3421	-25	4 ft.	4 ft.	Oil Sand
"	3425	-31	6 ft.	5 ft.	Anhy.-Shale, Sand
"	3490	3500	10 ft.	10 ft.	Anhy.-Oil Sand
"	3500	-04	4 ft.	4 ft.	Anhydrite
"	3599	-19	10 ft.	10 ft.	Anhy.-Shale
"	3519	-24	5 ft.	5 ft.	Anhydrite

REED ROLLER BIT COMPANY
CORE BIT RECORD

LOCATION—RODESSA, LOUISIANA
AVERAGE RECOVERY 84%

TYPE	FROM	TO	FOOTAGE	RECOVERED	FORMATION
REED KOR-KING			20 ft.	18.2 ft.	Oolitic Lime
"			15 ft.	12 ft. 1 in.	Oolitic & Shells
"			10 ft.	10 ft.	Coquina Lime
"			10 ft.	7 ft.	Oolitic Lime

REED ROLLER BIT COMPANY
CORE BIT RECORD

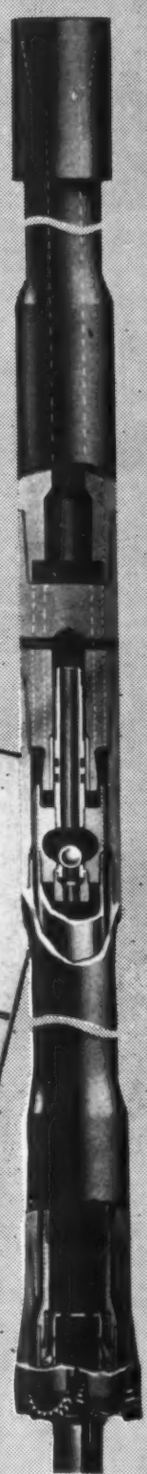
LOCATION—JAL, NEW MEXICO
AVERAGE RECOVERY 94%

TYPE	FROM	TO	FOOTAGE	RECOVERED	FORMATION
REED KOR-KING	3216	-22	6 ft.	4 ft.	Broken
"	3222	-29	7 ft.	5 ft.	"
"	3229	-37	8 ft.	6 ft.	"
"	3337	-56	19 ft.	18 ft.	"
"	3256	-76	20 ft.	20 ft.	"
"	3276	-95	19 ft.	19 ft.	"
"	3295	3315	20 ft.	20 ft.	"
"	3315	-24	9 ft.	5 ft.	"
"	3324	-34	10 ft.	12 ft.	"
"	3334	-51	17 ft.	18 ft.	"

REED ROLLER BIT COMPANY
CORE BIT RECORD

LOCATION—ARCADIA, LOUISIANA
AVERAGE RECOVERY 89%

TYPE	FROM	TO	FOOTAGE	RECOVERED	FORMATION
REED KOR-KING	5512	-17	5 ft.	5 ft.	Shale
"	5517	-37	20 ft.	19 ft.	Anhy. & Shale
"	5537	-56	19 ft.	17 ft.	Lime-Anhy.
"	5556	-76	20 ft.	17 ft.	Lime
"	5576	-97	21 ft.	18.5 ft.	"
"	5598	-18	20 ft.	20 ft.	Lime-Shale
"	5618	-26	8 ft.	7 ft.	"
"	5626	-35	9 ft.	9 ft.	"
"	5635	-55	20 ft.	19 ft.	Lime
"	5655	-75	20 ft.	15 ft.	"
"	5675	-85	10 ft.	10 ft.	Lime-Shale
"	5685	5704	19 ft.	17 ft.	"
"	5704	-24	20 ft.	14 ft.	"
"	5724	-39	15 ft.	13 ft.	"
"	5739	-55	16 ft.	15 ft.	"



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Geophysics as a Science

By DR. B. GUTENBERG

THE entire science of geophysics is seldom considered as a separate division of knowledge, comparable to geology or geography. Reasons for this attitude are discussed, notably the fact that no one person could hope to master entirely all parts of the geophysical field, or to become proficient in all the branches of specialized knowledge into which the subject, as a whole, may be divided. These subdivisions are discussed, and it is shown that many of them originally developed as branches of some other scientific field, from which they have ultimately become separated.

Gravity Meter Design and Operation

By DR. A. B. BRYAN

VARIOUS types of gravity meter are discussed, with a description of a particular type that has been successful in field work. Methods used in field surveys, costs of operation, and field results are given. The various corrections necessary are described.

Earthquake Investigations

By MARION H. GILMORE

SEISMOLOGICAL work of the Coast and Geodetic Survey began in 1925 with the transfer of the seismological work of the Government from the Weather Bureau. Earthquakes are a menace to life and property, but they are also a source of important scientific knowledge, for they give us information about the interior of the earth that we can obtain in no other way. All earthquakes originate in the outer parts of the earth, but they send out waves that penetrate through the center and can be recorded on delicate seismographs on the other side of the earth. The Coast and Geodetic Survey has developed instruments for recording strong earth motions; has recorded tilt of large areas; has determined dominant periods of buildings, water towers, dams, and of the ground; and has made special studies of a statistical nature.

Electrical Prospecting for Oil Structures

By J. J. JAKOSKY and C. H. WILSON

THIS paper describes a new electrical method for oil exploration and gives a brief discussion of the recent results obtained in the field work. Part A of the paper deals with the apparatus and theory of operation, the development history of the process, theoretical factors governing the flow of electric current through rocks, methods of analyzing the field data, and the general field technique. In addition a brief summary is given as to the applicability of the electrical method and its general function in supplementing other geophysical methods for fault location and structure mapping.

Part B of the paper describes various results obtained in the field work, by citing actual cases from surveys that have been conducted wherein the geophysical work has been followed by actual drilling or other development work. Various plates and illustrations are given to show the results obtained.

Magnitude and Character of the Elastic Waves Produced by Explosion Pressures

By DR. J. A. SHARPE

THE solution of the following problem is outlined: given a spherical cavity of radius a within an elastic medium of density ρ and compressional wave velocity v, to find the displacement in the elastic wave that is produced by the application of an arbitrary pressure $\rho\ (t)$ to the interior of the cavity.

The displacements corresponding to several of the forms of pressure application that may be produced by explosives are illustrated, and the relationship between these solutions of an idealized problem and the actual production of elastic waves for seismic exploration are discussed.

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Transient Characteristics of Seismograph Apparatus

By HAROLD WASHBURN

A METHOD of experimentally determining the transient response of seismometer, amplifier, and oscillograph is described. In the apparatus employed the earth motion is replaced by a transient wave generator and the seismometer by an equivalent electrical circuit.

Comparison of these laboratory data with field records has shown that accurate predictions can be made from laboratory tests.

Fundamental Relations in Seismometry

By S. A. SCHERBATSKOY and J. NEUFELD

THE equations for dynamical equilibrium of a geophone are derived by means of the Lagrange method and applied to the particular cases of a moving armature geophone, moving conductor geophone, and electrostatic geophone. The galvanometer for seismic recording is usually of the moving coil type and its equations are similar to those of a moving conductor geophone.

The magnetic type geophone as well as the galvanometer consist essentially of two dynamical systems characterized by an assymetric coupling: "the transducing resistance."

A brief analysis is given of the problem of determining the response of a seismograph to a given earth motion.

The Mapping of Faults by the Reflection Method

By HENRY SALVATORI

SUBSURFACE conditions associated with certain types of faulting are often such as to preclude the possibility of obtaining reflections in a region over and adjacent to a fault. Recognition of this fact is important as a sudden change in the quality of reflections should always be considered as a possible indication of faulting.

In regions where reflections can be correlated faults present little difficulty and the hade as well as the throw of a fault often can be determined. If correlation is impossible and dip shooting is used the determination of a fault presents an exceedingly difficult problem. In cases where reflections can be obtained continuously across a fault it can be usually detected by continuous profiling. Where, however, a continuous line of reflections cannot be obtained, the direct determination of a fault is impossible and its existence can only be inferred after a great deal of close shooting and the consideration of all related factors.

A New Source of Damped Wave Trains Suitable for the Testing of Geophysical Instruments

By DR. D. G. C. HARE

A NEWLY developed electric circuit is described, by means of which electrical transients of any desired characteristics may be conveniently produced. Oscillograph pictures of these transient waves before and after passing through elements of geophysical circuits are illustrated.

Use of the Sonograph in Mapping Faults

By CURTIS H. JOHNSON

MAPPING of faults has previously presented great difficulties for the reflection method. These difficulties have often arisen from a confused reflection pattern, rather than from entire absence of reflections near the fault. The use of the Sonograph in making a directional analysis of such confused patterns is described, and illustrated with several examples of faults located and mapped by this method.

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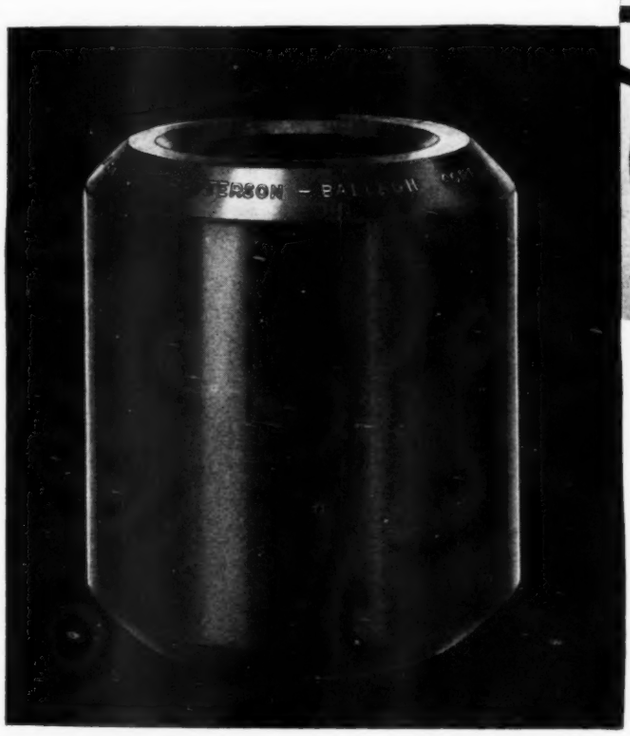

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Assembling a grid mosaic from contact prints

Applications of Aerial Photography To The Oil Industry

By GEORGE S. RICE, JR.* and JAMES C. ATKINSON*

OPERATORS naturally have a vital interest in the facts of the areas comprising potential oil territory, and consequently a need for maps of such territory in a form as accurate and comprehensive as may be obtained at an expedient cost. Information provided by maps is, of course, indispensable in all the branches of exploration —in geology, geophysics, engineering, and right up to the point where the block is ready for drilling.

The Texas Gulf Coast, East Texas, West Texas, Louisiana, Southern Oklahoma, the Southeast section of New Mexico, and Northern Mexico constitute a more or less integral area of tremendous proportions, most of which is considered favorable for possible petroleum production. This vast area, when first recognized for its latent value, called for revision and extension of exploration procedure by the many companies including it in their program. As a result, many new and difficult problems were encountered, one of the most important of which was the obtaining of usable map information on a substantial part of the whole area. This area had not been mapped to that degree of accuracy required by oil companies.

Aerial photographic mapping consequently was adopted by the petroleum industry about nine years ago, principally for its value as a picture of the land surface for geological work. The early product was lacking in scale accuracy and other control features that limited somewhat its effective use; however, even in its then primitive stage, it was accepted as an aid with at least the geological phase of the problem. That its results were produced in pictorial form was appreciated, but of equal importance was the fact that the results were achieved with incomparably greater speed than was possible with any other method.

The evolution of aerial photographic mapping from those first mosaics covering a few square miles to the product available today has been a steady if not a rapid one. It has been painstaking and of its very nature could not have been other than gradual. Into it have gone the benefits achieved by thousands of experiments and all the improvements that are found to result from the mapping of several hundred thousand square miles by various map companies. There has been continuous collaboration with oil company personnel relative to the application of aerial mapping in the various departments of an operating company and to the solution of the problems in connection with the practical and valuable use for each purpose.

The improvements in film and in photographic and developing equipment are reflected in the aerial photographic map of today, in the greater uniformity of color and clearness of detail. Probably the outstanding development, however, is the accuracy obtained with respect to scale and all other control features. Its ability to function as accurate horizontal land control, both local and regional, has greatly extended the range of its application. It continues to render the original service to the geologist, but now is used in the field of engineering and mapping phases of geological and geophysical work. The accuracy of scale and control has made possible the construction of photographically-controlled line and ownership maps far more accurate than ever has been possible heretofore. These maps have

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Line maps are controlled entirely by photographs. All lines visible in the photographs are enlarged, transparent celluloid placed over the pictures, and tracings made

proved invaluable not only in the geological and geophysical work but also to the land and legal departments in blocking leases and title-curing. The aerial map also has found valuable use in the location and construction of pipe lines and in various other activities such as irrigation and power projects. It should be noted that by reworking the mosaics, and in many instances rephotographing certain territory, the maps of practically the entire area covered have been brought up to the present standard. The accuracy and the many needs that that standard will fill perhaps may best be explained by a brief description of the various operations in the production of aerial photographic maps and the photographically-controlled ownership maps.

The area to be photographically mapped is divided into units called grids. These grids are geodetically-controlled polyconic projections of 7½ minutes of latitude and longitude, which in the latitude of Texas average approximately 65 square miles, or an eight-mile square. This grid system is carried throughout the building of the maps and is one of the chief factors making possible their accuracy.

When the rolls of film are returned to the laboratory they are developed with special equipment designed so that the film is permanently fixed and will not fade out. After drying, the roll is placed on a light table and each exposure is numbered in accordance with the coverage report and flight record of the pilot and cameraman. One set of contact prints is printed directly from the film. They are loosely laid out, roughly matching points of common detail, and checked with the coverage report to be sure the entire area is included and that all prints necessary to cover the 7½-minute grid are available.

The grid mosaic is constructed from the contact prints and the accurate scale determined. Each mosaic is built to conform closely with both local and regional ground control, consisting of United States Government and State triangulation and transit-traverse data, railroad, pipe line, and highway alignments, and all available private engineering control, including a considerable volume obtained by engineers in those areas where the control data from other sources are not sufficient for the purpose of scale uniformity.

The ratio of the scale of each grid to each adjoining grid is held constant by determining that the distance between all points of common detail along the borders are in proper ratio to the difference in the scales. Variance in the ratio of these distances may require the remaking of a mosaic. Any discrepancy in the border ratios is held well within a limit of one percent. No detail is overlooked in the constant watch for accuracy. Even the stretch and shrinkage in paper and film have been definitely determined and are taken into account at various stages.

Knowing the scale of the grid, and also the latitude and longitude of the government bench marks and of the grid corners, the location of the grid corners is accurately established. No single grid is considered completely worked until it is tied in to all its adjoining grids and these in turn all anchored to definite geodetic control.

The scale of each mosaic having been accurately established it may be photographically reproduced on any desired scale. As each grid corner, the

View of one of the departments of Edgar Tobin Aerial Surveys

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position of which is accurately known, is also a corner of three other grids, and the borders of all adjoining grids being in ratio to their respective scales, the result is that by photographic reproduction to the same scale a system of aerial photographic maps has been developed, comprising 125,000 sq. miles. Each unit is well within one percent of complete accuracy within itself and in its relation to the other units. The aerial photographic map of today represents a true picture of a vast area of potential petroleum producing territory, and any parts of the picture tie in with and are a perfect complement to any other part. Its authenticity as a map lies in the fact that it is a reproduction of the land itself, and though as such it is a miniature, yet in its size its scale is nearly as perfect as that of the original.

Aerial photographic mapping today does not stop with the purely pictorial. Improvements and refinements in the photographic maps and their achievement of almost complete accuracy indicated that they could form the basis for filling another service required by oil producers. The pictures show almost all the lines on the ground; so by tracing these lines from the pictures a map can be made that is likely to be more accurate than a line or survey map. The lines shown on the pictures must be placed properly on a line map of the same scale as the picture if traced directly therefrom. An even more comprehensive offspring, ownership maps, can be made from the photographic maps.

The thing to be particularly noted with reference to line maps is that they are controlled entirely by the photographs. All the lines visible are first enlarged on the pictures so that when transparent celluloid is placed over the pictures they will show clearly for tracing. Information from land office maps, county plats, and in Louisiana, parish maps and township plats, and ownership maps compiled by various oil companies are used to plot the survey lines on the pictures. As highways, railways, etc., appear on the picture, it is possible to place the survey lines very accurately. All lines are then traced off on transparent celluloid placed over the picture—showing the towns, cities, highways, tracts, rivers, creeks, pipe lines, transmission lines, railroads, survey lines, geodetic stations, and bench marks. The accuracy of their location is unquestionable because they appear exactly as on the ground. Latitude and longitude coördinates are added. From this, celluloid positives, negatives, and prints can be made on any scale. Ordinarily they are used on a scale of 1 in.—2000 ft., the standard scale of the picture, and also on a scale of 1 in.—1 mile and 1 in.—8000 ft. for regional work.

Contact with producers using the photographic and line maps has permitted a close observation of their use in the geophysical and geological departments. In each of the geophysical methods currently in practice, such as the seismograph, torsion balance, gravimeter, magnetometer, etc., the application of the controlled photographic maps is fundamentally the same.

The first use of the photographs is made by the permit man. They show him precisely what tracts of land will be occupied by the field party and enable him, when consulting and procuring permits from land owners, to define the boundaries of their property. He plots these boundaries on his photographic map for later use by the exploration party chief. This method eliminates the possibility of the party getting on the wrong land and the often ensuing damage suits. Such occurrences are especially costly in seismograph work.

The party chief begins his use of the photographs before he enters the field of operations, at which time he thoroughly acquaints himself with the details of the area he is to cover, and observes in advance all features that will both help and hinder him. He lays out his plan of procedure, down to the tentative plotting of his station lines. In the field he can conduct the movements of his party with the maximum efficiency. Having plotted on the photographs his actual station lines as laid out in the field, with any necessary changes from his preliminary plot, he ends the program in a given area, the complete record of his work being shown on the photographic base. That means that it is in correct relation with the land.

This work so recorded is reduced to a survey-line base, on both local and regional scales, by use of the survey-line maps (in celluloid positive form), which are built from the original photographic grids. From these survey-line positives accurate reproductions are made in any amount desired.

The photographs and survey maps both give special engineering information of value in geophysical work—government geodetic positions, latitude and longitude coördinates, elevation bench marks, etc. Whether a single

Aerial map showing structures and other geological information concerning a local area in Oklahoma

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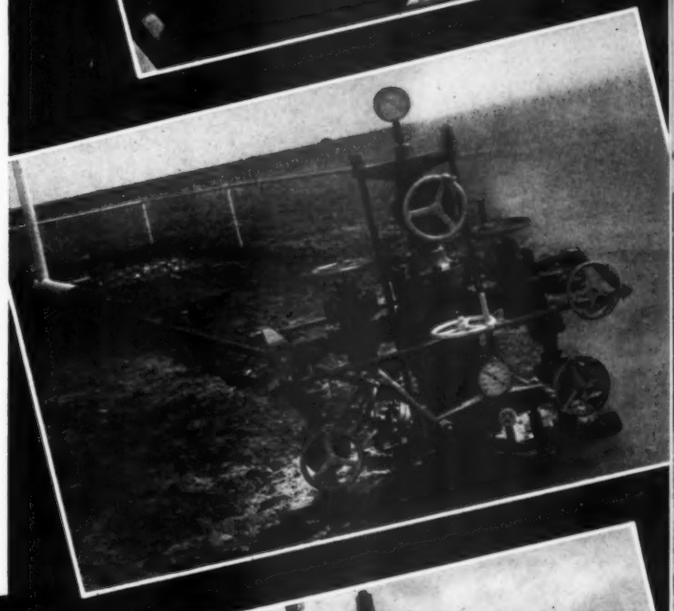

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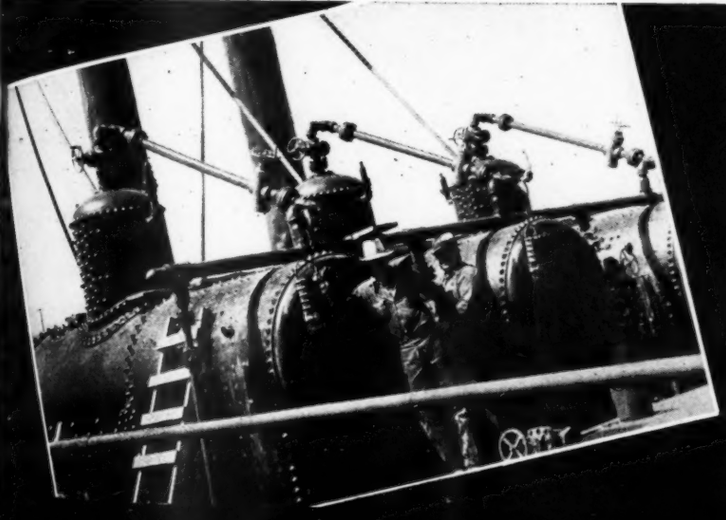

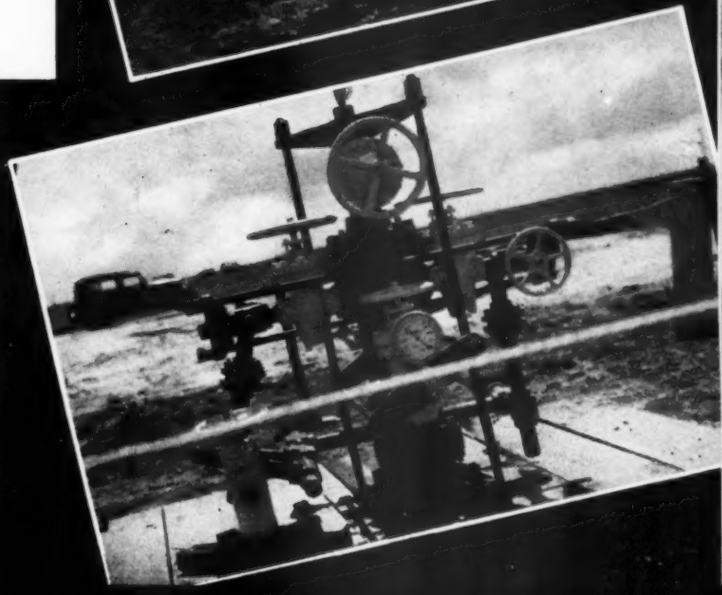

Aerial map of a small section of Louisiana

prospect or a broad region is being explored, or whether the work is reconnaissance or detail, the system in every case meets the requirements.

Some results of this method are: (1) time-saving in the field by reduction or elimination of horizontal control work and the expedition of movement; (2) frequent reduction in the number of stations or lines required efficiently to cover an area; and (3) assurance of accuracy in the findings and the increased value thus given to them. The value of (3) is probably the greatest, but is intangible; (1) and (2), however, yield definite cash savings, which in either seismograph or torsion-balance work largely retire the cost of the service. A further value is the time saved in the presence of competition.

The application of the photographic and survey-line maps is not less specific in the geological department. The surface geologist uses the photographic maps in a manner similar to that in geophysical field work. He studies the area he is to cover in advance, familiarizes himself with the terrain, and all roads, trails, and other means of traversing it by car or on foot. He also examines it closely for features of geological importance for subsequent examination of the ground. Outcrops, faults, contact swings, topographic highs, the different soil colors, the changes in vegetation, and the direction of drainage, all may be present on the aerial photographic map. In the field, he constantly uses them as a guide and a means of keeping himself located. The geological features he observes are plotted on the photographs in their exact position as he proceeds. No plane-table or other horizontal control work is necessary, as automatically everything is tied to the surrounding land features; hence he can devote all his time to geology.

When his field work is complete the information he has gathered is transferred from the photographs to a survey-line base, on the same scale as his photographs and on a regional scale, by means of celluloid survey map positives. Any information not included on the celluloid map, which he may want to show, is plotted in from the photographs. The complete celluloid map positive constitutes his final geologic map, and from it the negatives and prints are made.

Surface geology worked in this manner is not only correct from the mapping standpoint, but it is thorough and comprehensive. This is true because the field geologist, with the advantage of the vertical perspective on the land, is able to see and to reach every locality of possible interest; whereas without this assistance many such points away from the roads and trails might escape his notice. If additional time is required for the working of an area as thoroughly as is made possible by the photographs, it is offset by the elimination of horizontal control work, the time saved in getting about, and the improved quality of the results. The geologist's work on any area is complete and accurate the first time and probably need never be questioned nor done over.

The value of photographs to subsurface geology is obvious. The fact that photographic maps tie together on accurate scale over large areas is especially pertinent to regional work. The points sought to be correlated often are easily distinguishable on the pictures; and, if not, the field man can definitely place them on the map after actual location. In addition to the accuracy achieved, this method of course saves time, which in many instances is a paramount consideration.

The photographically-controlled ownership map undoubtedly is the most comprehensive and important development growing out of the present-day aerial map. It is just what its name implies—a map consisting of the ownership placed upon a picture of the ground and showing the land as it is actually occupied. As already pointed out, this means that the base of the map is the most accurate humanly possible to construct, being a reproduction of the land itself. At the very outset every tract is in correct relation with every other tract and with each highway, railroad, river, and other natural object. As a foundation there is a map in the form of accurately-scaled aerial photographs, showing not only all the foregoing but also fence lines, lanes, cultivated fields, wooded areas and clearings within them, buildings, and other erections.

Much money and effort that have been wasted as a result of inaccurate ownership maps. Many activities of an oil company are based on ownership maps, and as these do not portray the existing boundary conditions, it has happened frequently in the past that much useless acreage has been purchased and in every case much time and effort wasted.

Reflection Seismic Instruments and Their Efficiency

By DR. C. A. HEILAND

WRITERS on engineering subjects rarely find themselves in a position to discuss methods and equipment of wide commercial use about which practically nothing is published. Such is the situation with respect to seismic reflection equipment. No other type of geophysical equipment is used so extensively, no other geophysical method provides an equal depth accuracy, no other method of oil exploration approaches its definiteness in the interpretation of results. All this is accomplished with remarkable speed of field operation and with a minimum of calculations and corrections. It is estimated that the oil industry spends about $10,000,000 annually for the operation of some 175 to 200 reflection parties now working in the United States, Canada, Mexico, Venezuela, and Columbia and probably $2,000,000 to $3,000,000 more on research pertaining to the method.

The principle and theory of the process are simple enough. They are similar to the principle of reflection of light and of the echoes of sound waves. With an echo, the distance of a reflecting surface from the observer can be calculated when the time elapsed between generation and reception of sound is known. The same applies to depth determinations of geologic formations by seismic reflections. A seismic impulse is generated at the "shot point" by exploding a dynamite charge at the bottom of a hole drilled to a depth of 25 ft. to 150 feet. The instant of the shot is transferred to the recording truck by wire or radio transmission and recorded photographically.

The seismic impulses travel from the shot point to the receiving location in a manner somewhat different from that of light and sound waves in a homogeneous medium. The seismic waves reach detectors by three (or more) wave paths travelled with different velocities. First, the waves will go down on a detour to some near surface bed where they can travel faster than at the surface and thus will reach the receivers as *"First Breaks."* Second, part of the energy will go downward to the reflecting beds and come back as *"Reflections"* later in the record. Third, the portion of the energy travelling at the surface with slow speed generally will arrive at the end of the record and give rise to the so-called *"Ground Roll."*

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In 1925 he was sent to the United States to determine the possibilities of the American market for geophysical equipment. Since 1926 he has been professor of applied geophysics at Colorado School of Mines.

The vital part played by the author in the development of this art and its equipment lends authority to what he has to say on this highly technical subject.

The conversion of the vibration impulses arriving at the receiving locations is generally accomplished in *two steps*: First, by a conversion of mechanical into electrical energy; and second, by re-transformation of electrical energy into mechanical impulses with a light beam as magnifying lever. For the first conversion, electrical vibration detectors (also called pick-ups, or phones, or seismographs) are employed. For the second step, i.e. the photographic recording of electrical impulses, various types of galvanometers are used, together with a recording camera. Between the two, an amplifier is inserted to increase the signal strength; thus, a seismic recording "channel" consists of three units: the pickup, the amplifier, and the galvanometer. In addition to these three primary units, a seismic equipment has two secondary units, a shot instant transmission and communication system, and an arrangement for projecting accurate time lines upon the recording paper, generally at 1/100 of a second interval.

A brief description of the types now in prevalent use for the component parts of the recording channel will be necessary before their relative merits can be discussed from the point of view of efficiency.

All types of electrical pickups are very similar in construction to various microphones now in use, the only difference being that they are tuned to much lower frequencies, ranging from 5 to 100 cycles. They may be classified with respect to the type of "transducer" used to convert mechanical into electrical energy. In the "capacitive" type of pickup, the principle of the condensor microphone is applied; in the "electromagnetic" type, the principles used are those of the plunger coil and ribbon microphone, or those of the phonograph pickup. Electromagnetic pickups generally are subdivided into "inductive" (constant gap) and "reluctance" (variable gap) types. The third type of pickup is similar to the piezo-electric microphone using quartz or Rochelle salt crystals on which electrical charges are developed in proportion to the pressure of the impinging sound.

Another way of classifying electrical pickups is in respect to their frequency response. This depends not only on the type of transducer used but on the tuning of the vibrating mass itself in respect to the frequency range covered by reflected waves. The mechanical amplitude of a pickup tuned to low frequency (5 to 20) will be proportional to the ground displacement for waves of reflection frequencies, while when tuned to a higher frequency (around 100) it will correspond to the ground acceleration. This response is then modified by the transducer. For a condensor transducer, no modification in the mechanical response takes place. The electromagnetic transducers bring about a response that is proportional to the velocity of the motion, and the piezo-electric transducers generally produce response to acceleration. Combining this with the

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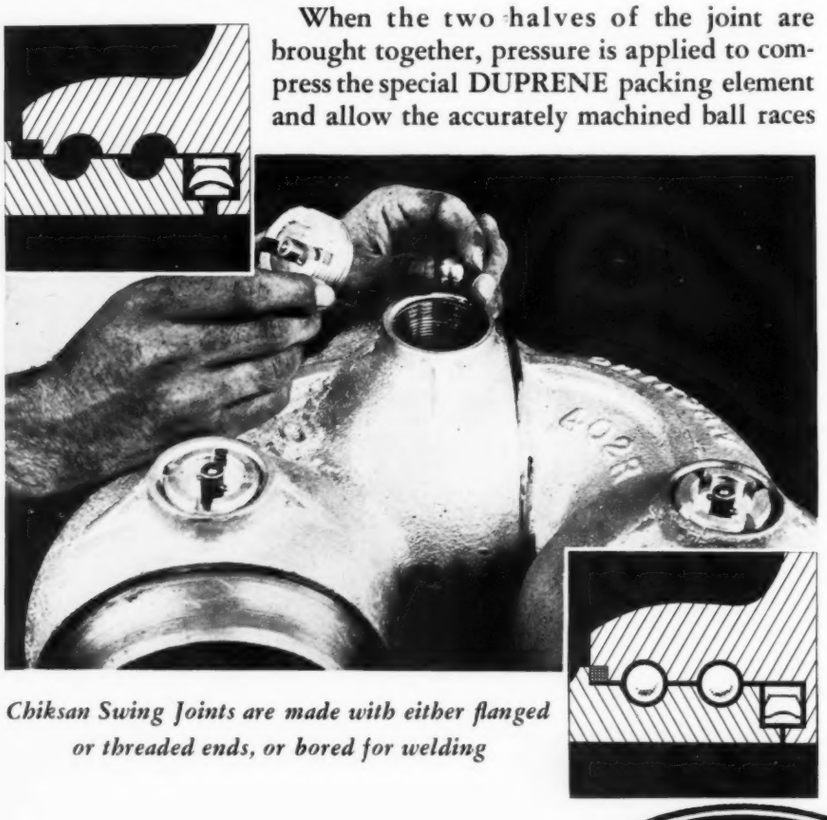

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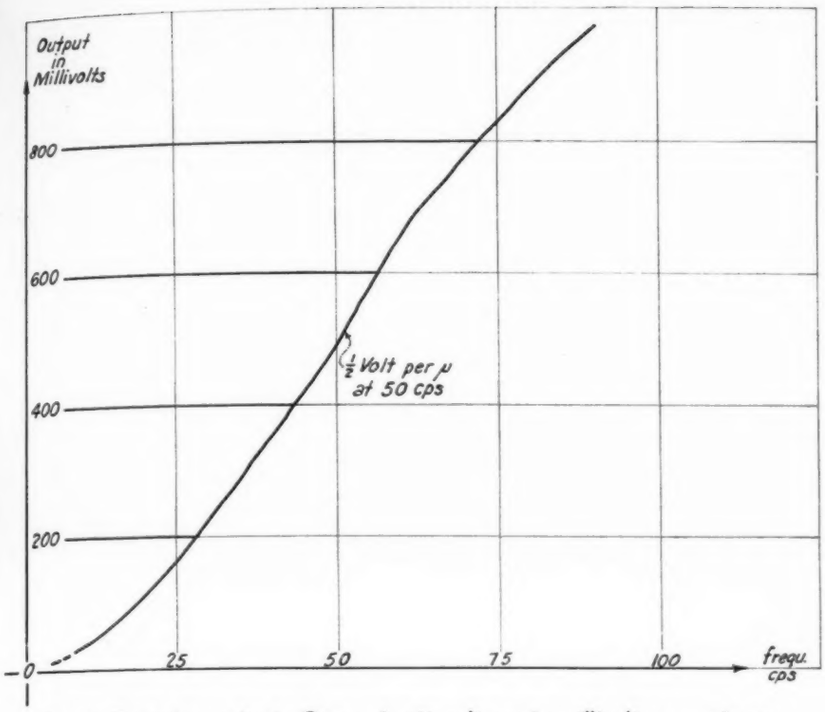

Fig. 1. Detector output. Open circuit voltage in millivolts per micron ground motion

mechanical response of the vibrating mass it works out in practice that most capacitive pickups record displacements; electromagnetic seismographs, depending on tuning, record velocity or acceleration and most piezo-electric seismographs record ground acceleration. In other words, the output of the first type is proportional to the zero power of frequency, the output of the second type proportional to the first or second power, and that of the third type is proportional to the second power of frequency.

In practice, electromagnetic types are used most frequently because of the disadvantages of the capacitive and piezo-electric types to be discussed later.

Seismic amplifiers follow a wide range of construction; they may have two, three, or four stages and may have resistance coupling alone, or resistance and transformer coupling, or combined resistance and impedance coupling, or transformer coupling alone. Regardless of interstage coupling, both pickup and galvanometer are generally coupled to the amplifier by transformers. Filter circuits for adapting the overall frequency response to the frequency of the desired reflections often are incorporated in the amplifiers.

Three types of recording galvanometers are now in general use. The first is a damped vibration galvanometer of the moving coil type. The second is a loop or "Duddell" type of oscillograph, and the third a string galvanometer of the "Einthoven" type. In the galvanometer of the first type, a coil is suspended by metallic strings in a magnetic field and acts the same as the moving element in any other type of ammeter or voltmeter. In the oscillograph, the coil is rather long and consists of a single turn fashioned into a loop moving between closely-spaced pole pieces of a magnet. In the string galvanometer, a harp of strings is placed between the poles of a electromagnet that are hollow to permit the excursions of the string at right angles to the magnetic field to be viewed under a microscope and to be illuminated from the other side. In this type galvanometer the shadow of the moving element is photographed, resulting in white traces on black background; in the coil and oscillograph types black traces on white background are obtained.

One channel composed of the three units discussed (pickup, amplifier, and galvanometer) is not sufficient for interpretation of reflection records. Generally, six and sometimes 12 pickups are used. An increased number of pickups is of advantage for "continuous profiling," which consists of a continuous detector arrangement not leaving any "holes" between subsequent shot points. The 12 pickup-arrangement requires 12 amplifiers and a 12-element galvanometer, and will be discussed presently. Great numbers of geophones also are required for the "series" arrangement. Its purpose is the elimination of refraction and ground-roll interference. A number of phones connected in series and set up at the correct distances will bring about a cancellation of waves with slow apparent horizontal velocity, while reflected waves arriving simultaneously from below will be reinforced. The main result achieved by series connection is thus the reduction in single receiver output required, with consequent reduction of pickup dimensions; however, as some operators use 36 and even 48 phones into 12 channels, most of the equipment is the same if not more than with only six or 12 single phones. Serious objections have been voiced against the series method, the principal one being that reflections may be "manufactured" in a record by this method. This objection has arisen from the fact that it is very difficult to know just what is recorded when, as is practiced by some, geophones are connected in all sorts of combinations, in series as well as in multiple. The writer does not believe that this criticism applies when geophones are connected in series in separate groups and then fed into separate amplifying and recording channels.

Another refinement is a provision to reduce the first impulses so that they do not overshadow shallow reflections, and at the same time to compensate for the decline of amplitude with depth. This may be accomplished in four simple ways. When a galvanometer unit with electromagnetic field is used, the amplitude of the first impulses may be cut down by reducing the field and by turning it up manually or automatically while later impulses are recorded. A second method is to rotate a bank of galvanometer-sensitivity controls while the record is taken. A third method is to insert this arrangement as a manual or automatic sensitivity control between pickup and amplifier or to use it interstage in the amplifier. A fourth method makes use of the time decay of a condenser discharge (a principle that was first used in 1876 and then revived before and after the war for ballistic measurements) to control the gain of the amplifiers; this produces a record in which the decline of amplitude with depth is compensated by increased gain.

To those familiar with the process of producing a sound record on a "talking movie" film it is evident from the foregoing that the technical problems of sound recording and reproduction and those encountered in the design of reflection equipment must be closely allied. In sound recording, the mechanical sound vibration is "picked

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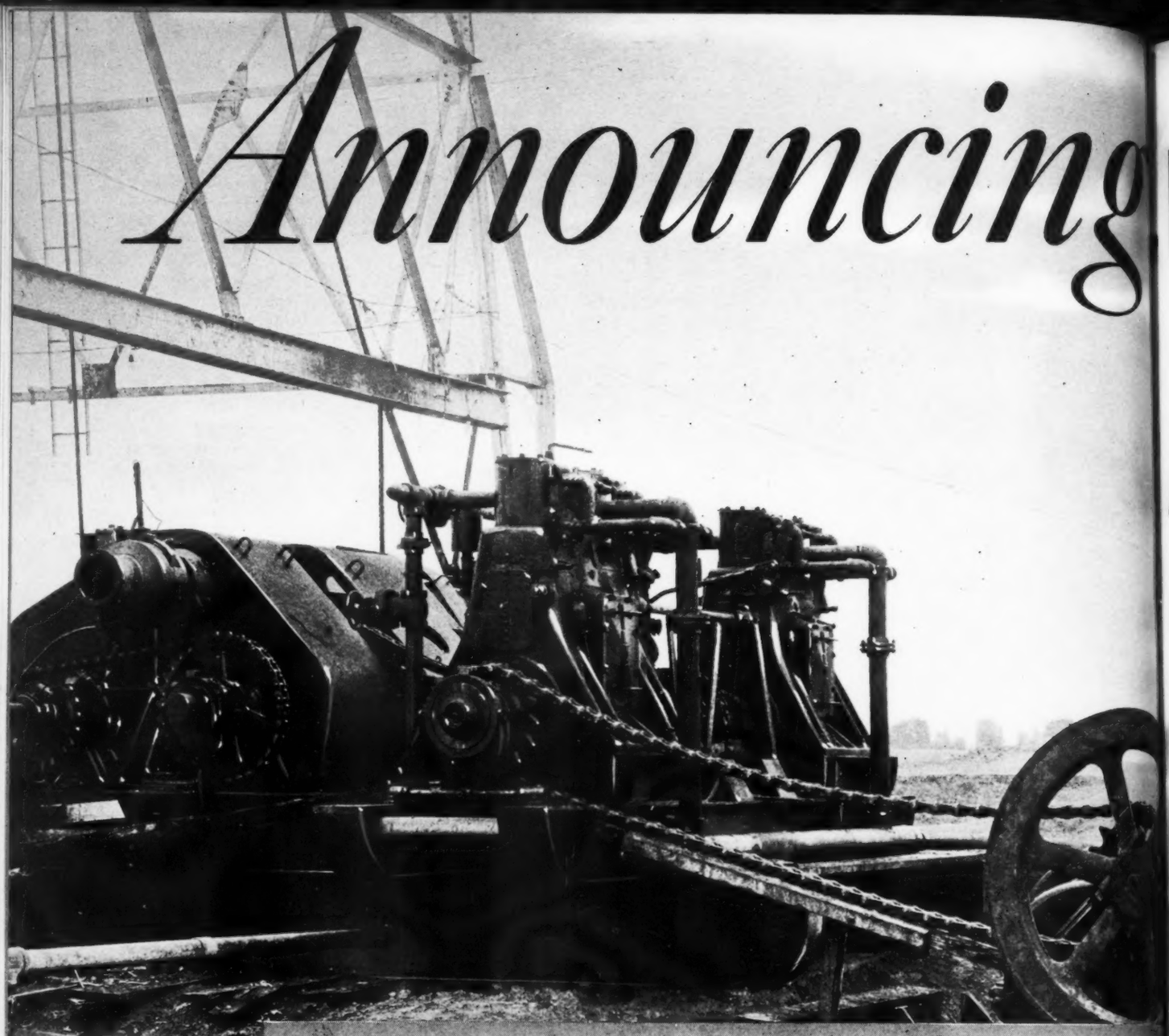

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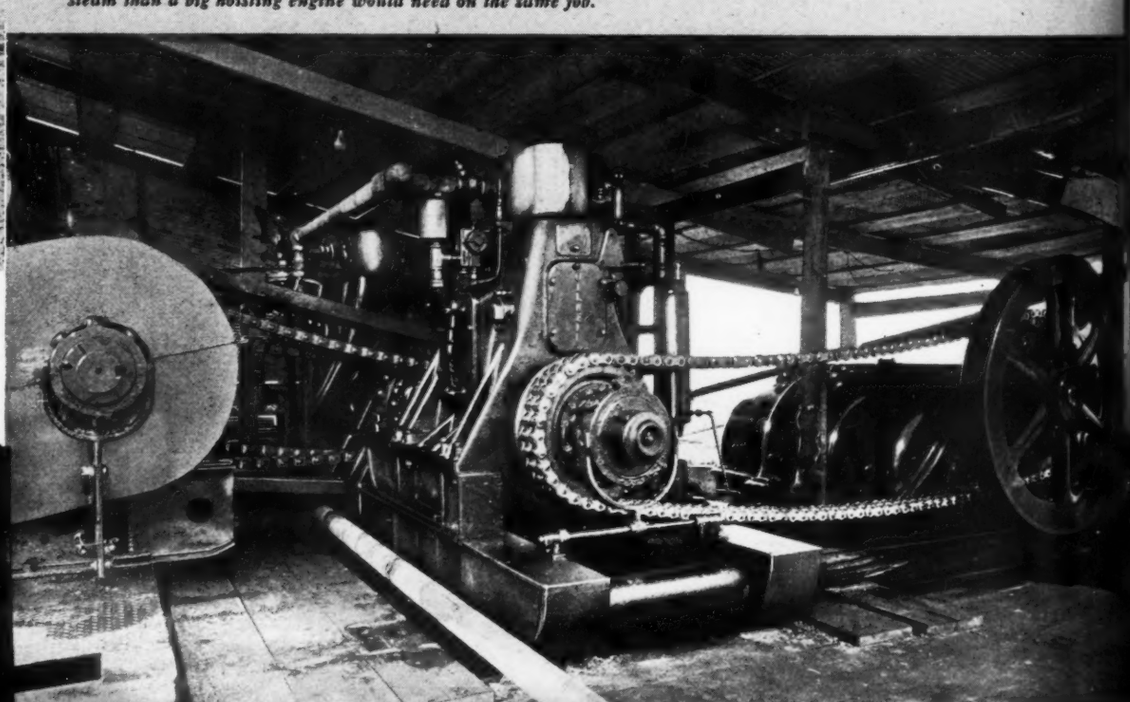

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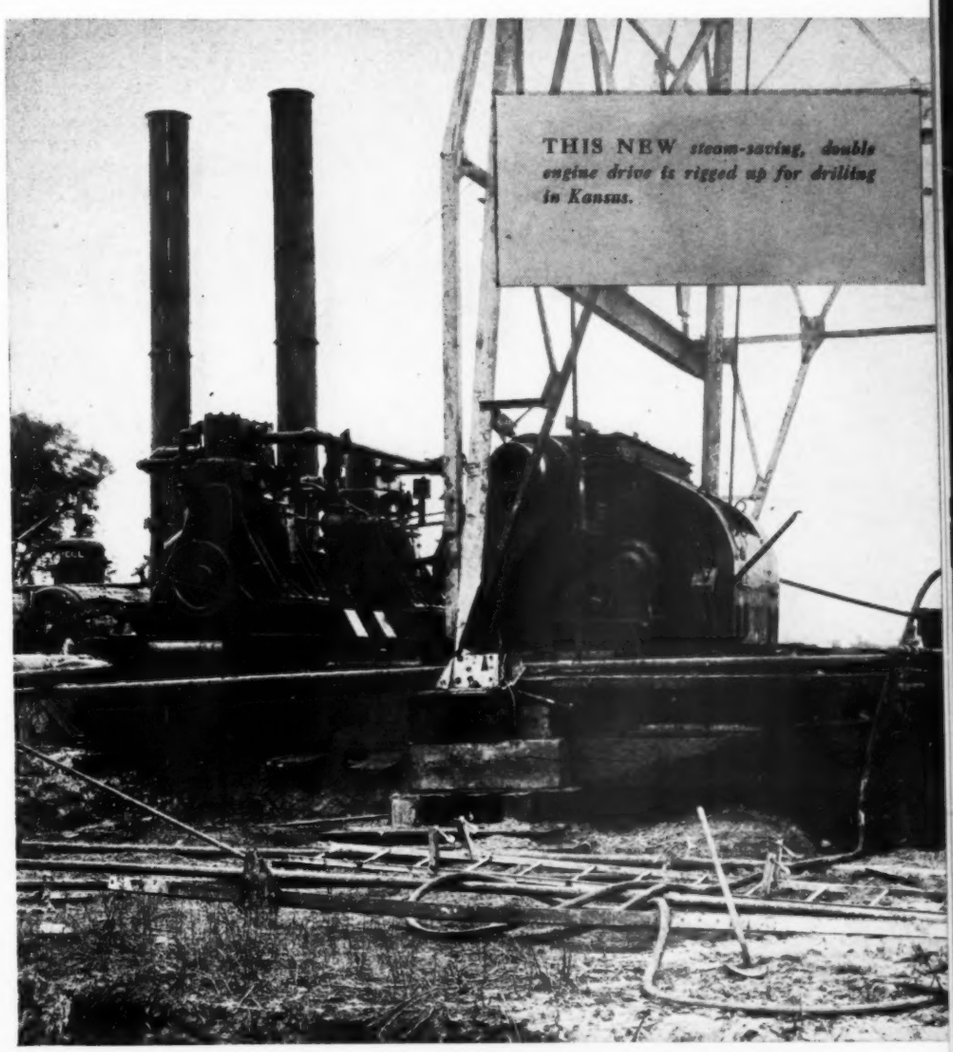

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up" by microphones, amplified, and recorded on film (in the R.C.A. system with a deflection galvanometer similar to the coil type, and in the W.E. system with a light gate that is a double-action string galvanometer). Up to this point the problem, except for frequency differences, is exactly the same in reflection seismology. While the talking picture engineer has the additional problem of transforming the photographic record back into sound, the geophysicist, fortunately, does not have to bother with such an addition to his many problems.

Considering the close alliance of these two fields, the question arises concerning what has been done in the geophysical field to benefit by the methods used in sound recording to improve quality of record and efficiency of equipment. In acoustic work, the designer of the microphone determines the output of the phone as a function of amplitude and frequency. He analyzes carefully the transmission characteristics of the amplifying channels. He is familiar with the dynamic response curve of the recording element.

Although, in seismic work, geophysicists have been working for some years on electrical refraction and reflection instruments, we still are much behind the acoustic design and testing practices. Efforts in equipment construction went in widely divergent directions. If, from the beginning, there had been as much unification as has prevailed in the development of field technique, much would have been gained toward the perfection of efficient equipment. Probably 20 different designs now are in use, some of which in all probability would be relegated quite unceremoniously to the graveyard if the same rigid tests were applied that have been found necessary to obtain maximum efficiency in acoustic engineering. The answer frequently heard to suggestions of this kind is that "it works" and that satisfactory or "good-looking" records are obtained. True, these are good sales points but they will lose their appeal when it is found that considerable savings in dynamite and drilling can be effected by bringing up the constituent parts of an equipment to greater efficiency.

It should be added that with our present knowledge, no general formula can be given regarding what type of pickup, or amplifier, or galvanometer should be used to obtain maximum efficiency. Various designs are of equal merit and their choice no doubt will be governed largely by personal experience and taste; however, there are certain fundamental considerations that must be applied in the construction of any one or combination of these to reach greater efficiency.

The question arises how best to define efficiency of seismic equipment. Its function is to magnify the ground motion and to eliminate undesired impulses as much as possible. Therefore, its first requirement should be to have the necessary sensitivity at the requisite frequencies—i. e., the overall magnification must be as great as is consistent with trouble-free operation.

The usable overall magnification of seismic equipment is limited by ground unrest, wind, etc. An equipment that has a capacity of giving a maximum overall of around ten million (i.e. ten millimeters galvanometer deflection on the photographic paper for a ground motion of one milli-micron) undoubtedly will be satisfactory for all practical purposes.

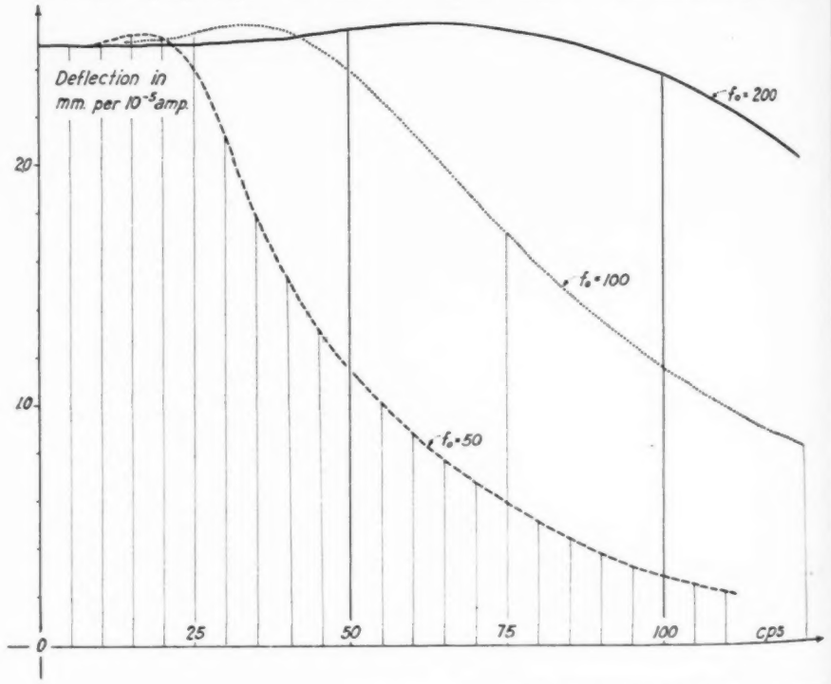
As there are three component parts in every channel, it might be assumed that it should be immaterial how the overall magnification is obtained. This conclusion is not borne out by practical experience; for instance, if both the pickup and the galvanometer were inefficient, an amplifier of very high gain would have to be used. This not only means a high noise level, but such field interference as cross-feed, shot-instant coupling, tuning-fork pickup, microphonics, and pickup from power lines. If the pickup is inefficient and the galvanometer is made too sensitive, it may mean unsteadiness of the zero position and probably most of the field interference already mentioned, as the galvanometer would be too sensitive to anything picked up by the amplifier.

To obtain the right balance in the sensitivities of the component parts it is only necessary to adopt the experience obtained in acoustic engineering. It has been found that for best reproduction and minimum of interference, the energy level at the source must be as high as possible. This means, first, maximum efficiency of the pickup. Inasmuch as the required overall magnification cannot be obtained by the pickup alone without giving it an impractical size, it also means a highly sensitive galvanometer.

Hence it is not the maximum overall magnification of an equipment, but the maximum *usable* magnification that determines the performance of a seismic equipment. This usable magnification depends on a judicious distribution of sensitivities among the component parts. Incidentally, it does not make too much difference whether the high signal level at the source is obtained by the construction of the pickup alone or by it *and* the addition of a pre-amplifier contained in the pickup. This is common practice in condensor microphones and piezo-electric microphones.

Having found a high output of the pickup and high galvanometer sensitivity the most essential requirements, a good *measure* for the *efficiency* of a seismic equipment is the *overall magnification obtained when the pickup is connected without truck amplifier to*

Fig.2. Response to three galvanometers with different natural frequencies, showing varying degrees of cut-off in higher range of reflection frequencies



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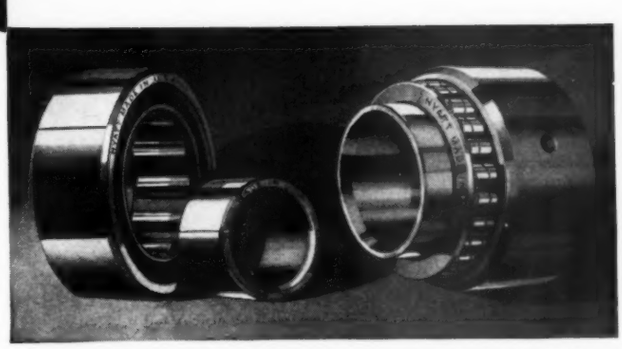

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the galvanometer. A convenient unit to measure this is millimeter deflection per centi-micron ground motion. A shaking table is required for making this test. For the pickup whose response curve is that shown in Fig. 1, and the 200-cycle galvanometer curve shown in Fig. 2, the writer has obtained a deflection of 2.5 millimeters per centi-micron ground motion, which is equivalent to an overall of 250,000 at that frequency.

The sensitivities of pickup and galvanometer alone are not quite sufficient to characterize the efficiency of reflection equipment from the point of view of field operation. Size and weight are important considerations; therefore, the pickup efficiency can be measured by the *output* (per unit ground motion at reflection frequencies) for a given *weight* and *size*, and the galvanometer efficiency by its *sensitivity* (in millimeter deflection per unit current at reflection frequencies) for its *weight* and *size*. As a characteristic frequency, 50 cps. is best chosen. For a more complete description of the response of either pickup or galvanometer, the entire dynamic response curve must be considered.

To give an idea of the possibilities in the design of pickups and galvanometer, reference is made to Figs. 1 and 2. Fig. 1 represents the open circuit output voltage (as available on the grid of the truck amplifier) of the writer's latest pickup. At 50 cps., an open circuit voltage of one-half volt per micron ground motion is obtained. This pickup is five and one-half in. high, four in. in diameter, and weighs eight pounds. Fig. 2 (solid curve) shows the response of a 200-cycle galvanometer, in millimeters per micro-ampere, as a function of applied frequency. This unit has a static sensitivity of 0.25 mm. per micro-ampere, is self-contained with permanent magnet, 8½ in. high, ¾ in. in diameter, and weighs *one pound*. The writer also has designed a 12-element galvanometer with electromagnetic damping, static sensitivity 0.1 mm. per micro-ampere, measuring 4¾ in. by 4¾ in. by 7½ in., and weighing 15 pounds.

In the general description of seismic reflection equipment, it was stated that three different types of pickups and three different types of galvanometers are now in predominant use. It remains to consider them from the point of view of greatest efficiency.

The condenser type seismograph is light, may be adjusted readily to any desired frequency, and has the advantage of air or electromagnetic damping. Generally it is employed with oscillator in the pickup case. The writer has too little information on this type to make any statement regarding its output. It is said to require multi-conductor connecting cables of comparatively large diameter. This type seismograph is used by one company only and has not been adopted generally.

The inductive type of electromagnetic detector can be designed to give large outputs for small dimensions. It also has the advantage that it may be damped electromagnetically and has a straightline frequency response.

Reluctance type pickups give still greater output than inductive types, but frequently are somewhat heavier. It is easier to obtain high than low natural frequencies; therefore, they are more readily adapted to Mid-Continent and similar areas, while the inductive type appears to be better suited for Gulf Coast work. Most of the types now in use have oil-damping. The low frequency types have a natural frequency of around 15 cycles and the high frequency types around 100. The former have fairly straight-line characteristics, while the output of the latter is proportional to the square of the frequency, making them inefficient for low-frequency applications.

The piezo-electric type is, to the writer's knowledge, used by one company only. Its output is low and, therefore, trouble often is experienced with static and electromagnetic pickup.

Summing up the detectors, the inductive and reluctance types can be made into more efficient units than the capacitive and piezo-electric types. The inductive types have the advantage that they can be used with lower natural frequencies in areas requiring it, and that high output can be combined with electromagnetic damping.

With reference to recording galvanometers, an electrical and optical sensitivity may be distinguished. Combined they give the overall sensitivity of the galvanometer. In the reflecting type galvanometers the customary recording distances appear to be about 25 and 50 cm., and, therefore, the overall sensitivities of different galvanometers readily can be compared. Regarding optical sensitivity, the multi-element string galvanometers are at a decided disadvantage compared with the coil galvanometers and oscillographs. In order to get a harp of six or twelve strings into the field of one microscope, its magnification must be kept low (to a power of about 50 to 80). In spite of this low power the spacing of the strings usually is too close for field applications as they have a tendency to tangle during the first impulses. String galvanometers generally are provided with strings of high frequency. Though this is an advantage for maintaining straight-line response for all reflection frequencies, the disadvantage is that such strings cannot be damped readily; for sudden transients, therefore, undesirable decay curves may be recorded. The high frequency gives rise to a low sensitivity, about ten mm. per milli-ampere for a multi-string harp, which is 25 times less sensitive than that of an oscillograph galvanometer of 200-cycle frequency with oil-damping. Obviously, the solution for all this difficulty would be a fairly loose string in the field of one microscope. A camera of foreign make is built in this manner, but size and weight are increased considerably. Considering the inconvenience of white trace on black background, it is concluded that, notwithstanding their fairly widespread use, multi-element string galvanometers are not the most efficient types for reflection work.

Loop oscillographs, on the other hand, can be made small, self-contained with permanent magnet if desired, of high enough natural frequency to be practically flat in the important range, damped to 0.7 critical or to critical, and with a sensitivity of 0.25 mm. per micro-ampere or more if desired.

Most types of coil galvanometers now in use have an unnecessarily low sensitivity (about three mm. per milli-ampere at 50 cycles). Their natural frequencies are too low so that only half their static sensitivity is obtained at reflection frequencies. By means of suitable design not only the frequency but also the sensitivity can be increased considerably (the latter by about 25 times). The response curve may be made reasonably flat out to 50 cycles; electromagnetic damping may be provided so that variations in damping or necessity of changing oils with seasons are obviated.

Summing up the discussion on recording galvanometers, it appears that the most suitable types are oscillographs and coil galvanometers. The latter probably are preferable because they allow to combine fairly high natural frequency and sensitivity with electromagnetic damping. As the two dotted curves in Fig. 2 show, the dynamic sensitivity for impulses equal in frequency to the natural, is about half the static sensitivity for near critical damping. Although the rising characteristic of an electromagnetic seismograph counteracts the galvanometer characteristic to some extent, its natural frequency must not be so low that a drop in the overall response curve occurs where actually the greatest sensitivity is desired.

Quantitative Determination of Adulteration of Lubricating Oils by Means of Identifiers • • Part 3

By S. FISCHER, JR.

NICKEL Oleate. Apart from the final principle of "camouflaging," the problem of identifying one's own oil in the crankcase offered the greatest difficulty. The company for whom this work was done stipulated that some identifier had to be developed that would show at least qualitatively, the presence of their oil in the crankcase.

Much had to be taken into consideration in connection with this work. First, all the used oil collects in the crankcase. This oil, because of usage, ordinarily is different in composition from the original oil. It will have decomposed to a greater or lesser degree; it will be more or less diluted with gasoline, and, finally, it will be mixed with calcareous and siliceous materials as well as carbon.

The writer often has wondered if the carbon formed in the cylinders of an automobile could account for all the decomposition of the modern lubricating oils. He came to the conclusion that this is not possible. There must be other sources of carbon formation in an automobile. Decomposition of organic material occurs usually at comparatively low temperatures. An automobile traveling over the open roads and in the cities picks up dust and sand. Siliceous materials are very hard and when ground into bearings create, at the place of grinding, very high temperatures — sufficiently high indeed to cause organic materials to break down with carbon formation. Most modern cars have pressure lubrication, the lubricant being recirculated over and over again, forming more and more decomposition products and more free carbon.

All substances so far discussed also were tried after use of the oil in cars. None proved satisfactory, especially from a quantitative angle. It therefore was deemed necessary to use substances a part of which would remain quantitatively intact. The outcome of the search for such a material or materials was the use of metallic oleates, palmitates, and stearates. Of these the oleates were chosen, not because the others would not work, but rather due to the fact that the oleate made use of in this test could be more readily prepared from oleic acid. The ultimate compound chosen was nickel oleate.

This compound was not on the market at the time and so it was prepared in the writer's laboratory. C.P. and U.S.P. chemicals were used and the product could be prepared of uniform composition at an approximate cost of 32 cents a pound. Add to this 32 cents a lb. for labor and the cost per lb. of the nickel oleate is 64 cents. This figure is high.

*Treatment of a 2000-gal. batch of oil with nickel oleate*s Place 2000 gal. of oil in a suitable blender, agitate and heat to 150 deg. fahrenheit. Meanwhile weigh out 500 gm. of nickel oleate into an iron ladle and heat to between 95 deg. cent. to 140 deg. centigrade. When the oil is at the required temperature introduce the molten oleate into the oil, rinse the ladle well, and agitate at 150 deg. fahr. for from 15 to 30 minutes, the length of time necessary depending on the viscosity of the oil. Then place in drums.

Quantitative determination for nickel: Any method may be employed for this purpose. The essential feature is to weigh out a sufficiently large sample of crankcase oil and incinerate it thoroughly and extract the ash with hot mineral acid. This solution will contain the nickel and other acid-soluble mineral products. From this solution determine the percentage of nickel present and calculate back to the original oil sample. A refinery-prepared sample should be analyzed for comparison of nickel content.

The outstanding feature against a quantitative determination in the crankcase is the fact that the nickel oleate accumulates in the crankcase. If one would take five quarts of oil and run it without further addition of oil, then a quantitative determination would be of value; however, this is not the practice. One usually adds a quart here and a quart there and the method of comparison therefore is of no value. It is for this reason essentially that the idea of a quantitative test for the oil in the crankcase was abandoned.

Even a qualitative test is really of little value. Of what use would such a test be? One could only say: "At one time or another, our oil was used in this particular car." Nevertheless, the nickel oleate provides a satisfactory qualitative test on crankcase oils in terms of the nickel salt of dimethylglyoxime, which is a precipitate and has a characteristic pink color.

Out of the qualitative test for nickel with dimethylglyoxime a very interesting test was developed. If ten cc. of the oil containing the nickel oleate is mixed with ten cc. of ether in a separatory funnel and shaken with ten cc. of a 10 percent hydrochloric acid solution for ten minutes all the nickel in the oil is removed and will be contained as nickel chloride in the hydrochloric acid extract after permitting the mixture to settle or after centrifuging the oil-ether-hydrochloric acid mixture. Draw off the bottom layer containing the nickel and add to it eight cc. of a solution made up of 99 cc. of test solution used for the Oil Brown M. test and one cc. of a concentrated solution of dimethlyglyoxime in alcohol. Add an equal volume of distilled water. Filter. The filtrate will have the peculiar red color of the nickel salt of the dimethlyglyoxime, which ordinarily is a voluminous precipitate. The duration of the color appears to be permanent. A solution so obtained on November 2, 1932, showed no apparent change in its color intensity on August 26, 1935.

The writer has not had time available for the closer study of this reaction in order to claim a quantitative method for nickel. It would seem, however, that the reaction is quantitative, as no residual nickel ever was discovered either in the oil used for the test for nickel after extracting with acid or in the material left on the filter paper after this material was carefully washed with dilute acid.

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Naturally the nickel, which functions as the actual identifier, is stable to all conditions that have been mentioned in discussing other identifiers. One pound of the nickel oleate as produced, calculating on the basis of 0.25 gm. of the nickel oleate per gal. of oil treated, will be sufficient for 1816 gal. of oil. Of this 0.25 gm. of nickel oleate only .0102364 gm. is nickel. This is equal to 0.0000063 gm. nickel per cc. of oil. The sensitivity of the nickel as used in the oil then is one part of nickel by weight per 158,730 parts of oil by volume.

The Principle of Camouflage. The writer would not recommend any of the individual identifiers discussed as a fool-proof medium for the identification of adulterated oils even qualitatively. The reason for this statement is that, though some of the identifiers would, in themselves, be difficult to detect, yet this detection is possible and then any court action would be null and void. Luck, as you know, very often favors the wrong party.

For the safety of the producer of such identifiable oils, recourse was taken to what the writer terms "camouflage." The principle of camouflage is very simple—use one identifier to cover the other. This is not the same principle as is used with the so-called mixed indicators. These latter serve the purpose of detecting different elements, substances, bacteria, etc. In the case of adulterated lubricating oils, the use of several identifiers serves the purpose of protecting the producer against the possibility of a person adulterating his stock, who, by luck or otherwise, might discover a "single identifier" contained in the producer's oils. The detection of all components in a camouflaged identified oil is difficult and highly improbable. Camouflage here then means protection.

The Oil Brown M-Phenolphthalein-Hexalin Identifier. The principle involved is to use the pH value of the phenolphthalein. The Oil Brown M serves as a camouflage, at the same time it also can be used as a quantitative determination for adulteration. If both the phenolphthalein and the Oil Brown M determinations check, there would be little doubt in a jurors mind regarding the just assertion that an oil is adulterated.

Treatment of a 2000-gal. batch of oil: The identifier stocks are the same as those described under the phenolphthalein-hexalin identifier and the Oil Brown M identifier respectively. The same precautions mentioned in discussing these identifiers individually hold true for their combined use.

Introduce 2000 gal. of oil into a suitable blender, agitate and heat to 150 deg. fahrenheit. Introduce 320 gm. of Oil Brown M paste followed by 224 cc. of phenolphthalein-hexalin identifier. Maintain at 150 deg. fahr., constantly agitating the oil for approximately 30 minutes. Place in drums for the market.

Identification test for adulteration: This test must be followed exactly as described, otherwise one will get only a test for the phenolphthalein and no test for the Oil Brown M. This is imperative. Introduce 15 cc. each of a standard plant-treated oil and the suspected oil into two separatory funnels. Mark these funnels S and U respectively. To each funnel add 15 cc. of ether and shake to mix. Then add to both tests 15 cc. of the test solution used for the identification of the phenolphthalein. Shake ten minutes, allow to settle or centrifuge, and follow out carefully the steps given for the identification of the phenolphthalein. Make up both extracts to the same volume, using test solution for this purpose. Then determine the phenolphthalein colorimetrically.

To the oil-ether extracts remaining after the extraction for the phenolphthalein, add 40 cc. of the test solution used for the identification of the Oil Brown M color. Shake each sample ten minutes and proceed exactly as was recommended under the Oil Brown M identifier. After obtaining the extraction liquor containing the Oil Brown M color, make both samples up to the same volume with test solution and determine the Oil Brown M content.

Having both the phenolphthalein and the Oil Brown M determinations one may then calculate the percentage adulteration as already explained. The results in Table 5 will show the efficiency of the process of identification of the adulteration. Nessler tubes were used.

An interesting question arose in discussing the application of this combined Oil Brown M-Phenolphthalein-Hexalin identifier. It is essential that batches should be capable of duplication, otherwise the identifiers are valueless. For this reason, two different 50-gal. batches were treated as nearly identically as possible. These were then compared for their phenolphthalein and Oil Brown M content. The Oil Brown M content for both batches showed 100 percent, while the phenolphthalein tests showed 98.2 percent for the first batch and 102.6 percent for the second batch, Nessler tubes being used in making all tests. The average percentage of phenolphthalein was determined as 100.4 percent, which certainly proves that batches are capable of duplication.

Whatever has been said about the individual components holds true for their combination. The amount of the identifiers used for treatments may be reduced, but larger volumes of oil must be taken for the tests; it will require more ether, but most of it can be recovered; finally it must be remembered that there is no change in the volume of the respective extraction solutions used even for the greater volumes of oil and ether.

Combinations of the identifiers however, offer many more advantages than do the individual identifiers. The presence of both identifiers makes the detection of the individuals more difficult. The method of extraction of the colors is fixed and cannot work in the reverse or in any other fashion. A double check of the amount of adulteration is readily obtained on one sample alone. Above all, the legal protection is increased many fold.

(Continued on page 106)

TABLE 5

Results Obtained by Use of Combined Phenolphthalein-Hexalin and Oil Brown M. Identifiers.

1	2	3	4	5	6	7	8	9
Prepared Samples		% R.T.O. Determined		Av. % R. T. O. Determ.	Approx. % R. T. O. Determ.	Approx. % Adult. Determ.	Av. % Error R. T. O.	Actual % R. T. O. Col. 1 and Col. 5
% R.T.O.	% A.O.	In Terms of F.	In Terms of O.B.M.					
20	80	19.20	21.71	20.46	20	80	0	+0.46
40	60	42.60	39.75	41.18	40	60	0	+1.18
50	50	50.56	50.70	50.63	50	50	0	+0.63
75	25	74.07	73.00	73.54	75	25	0	−1.96
90	10	89.29	88.63	88.96	90	10	0	−1.04
100	0	98.97	99.10	99.04	100	0	0	−0.96

ABBREVIATIONS:
R. T. O.—Refinery Oil Treated with Oil Brown M. and Phenolphthalein-Hexalin Identifier.
A. O.—Oil used as Adulterant.
F.—Phenolphthalein.
O. B. M.—Oil Brown M.

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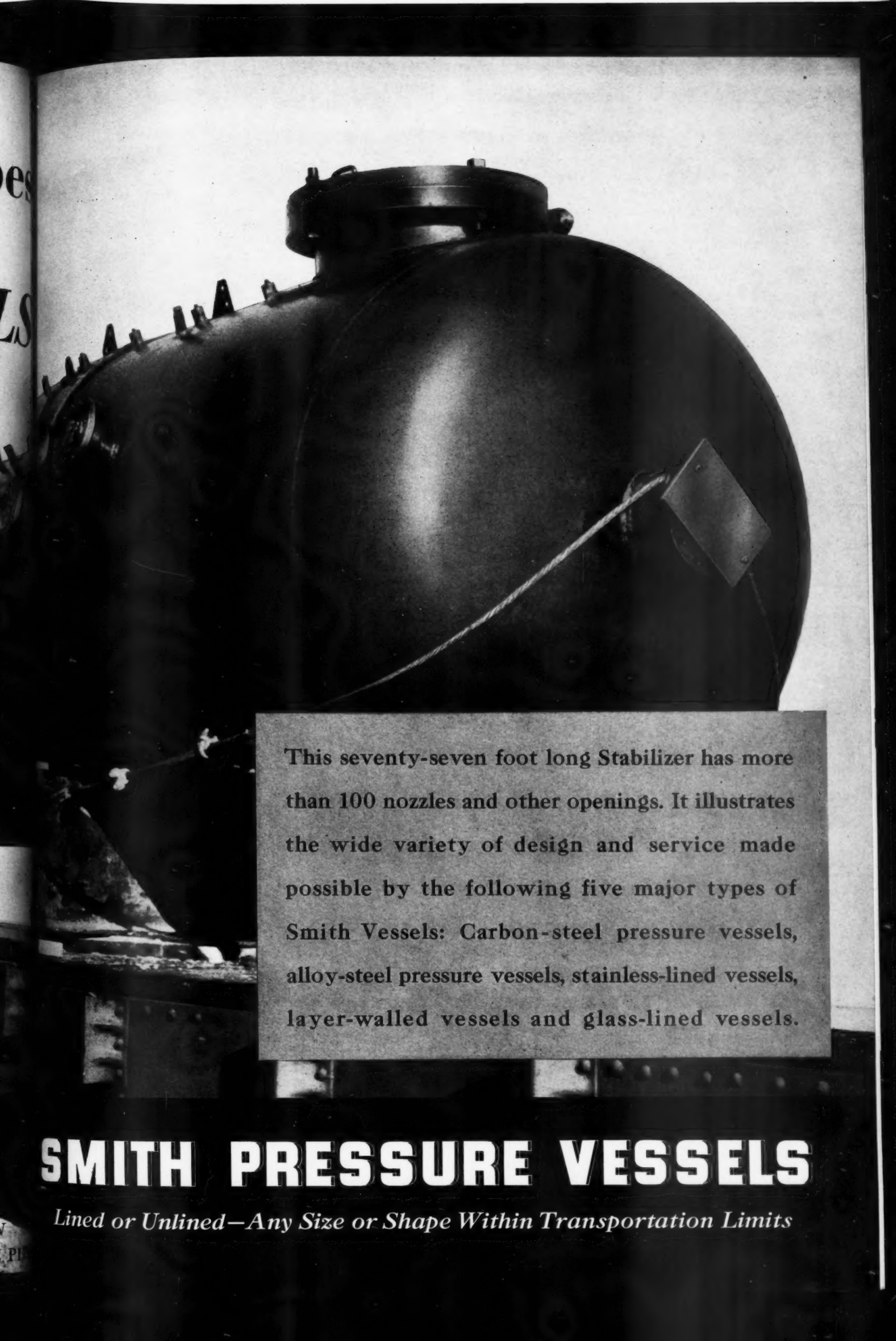

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SMITH PRESSURE VESSELS

Lined or Unlined—Any Size or Shape Within Transportation Limits

(Continued from page 103)

The sensitivity of the combination will be that of the individual components *per se*. The cost per gal. of oil treated with the combination is only slightly greater than that of the treatment with the individual components, namely $0.0004778 for the combination, as against $0.0003616 for the Oil Brown M test, and $0.000116 for the phenolphthalein identifier. Though the value of the combination identifier is close to the one-half cent per gal. limit, it must be remembered that the price given undoubtedly is high and may be materially reduced, as it is the custom of the writer to quote maximum rather than minimum prices in all estimates.

It is of interest to note what effects are produced upon an oil by the use of this combination of identifiers.

	Untreated Oil	*Fischer Identified Oil*
Gravity	28.6	28.6
Flash	445° F.	445° F.
Fire	500° F.	500° F.
Vis. at 100° F.	468. 6 sec.	474.6 sec.
Vis. at 210° F.	64.2 sec.	64.3 sec.
Pour Test	20	20
Color	1.65	1.35
Sligh No.	4.70	4.40
Carbon Residue	0.59	0.54

During the work on this particular identifier the accuracy asked for by one company was between five and ten percent. This accuracy was asked for by the western branch of the company, because of the Nessler tube method of color testing. Table 6, column 2, shows the types of samples prepared by the eastern branch of the company for the determination of the percentage adulteration—fractions of one percent, with an allowable five to ten percent error.

When these samples were submitted for test, they were submitted without data, merely numbered. In Table 6 are the results obtained on these tests, doubly checked by the Oil Brown M test and the phenolphthalein test. These percentages, it will be observed, tally in columns 2 and 3. Note the average in column 4. Column 5 gives the values found for the percentage of adulterating oil added to the Fischer identified oil. The writer was informed that all the results were wrong. Check samples were made up by the western laboratories of the company according to data received from the eastern branch of the company.

The numbers on the bottles were covered with adhesive tape before the samples were tested. All samples were then tested in one day. After removal of the tape, the order in which the samples were tested is that given in column 1, Table 7. The individual tests giving the amount of Fischer identified oil present in the samples in terms of Oil Brown M and phenolphthalein are given in columns 4 and 5. The average from both determinations is itemized in column 6. The amount of adulterating oil is shown in column 7. It is interesting to compare these values with those given in column 2. The percentages of error in column 8 all lie within the allowable limits of error demanded by the firm, namely within from five to ten percent. The first few samples show a markedly low error, the errors increasing toward the end. Considering the fact that two persons had to match colors well over 100 times a day, the results are within reasonable limits of accuracy as a whole, and the increase in the percentage of error is readily understood.

Now consider closely, column 9, Table 7. This gives the percentage of error as it would have been had the adulteration of the samples submitted by the eastern branch been within the limits of five to ten percent. These errors are obtained by subtracting from the larger values in column 2, Table 7, and column 5, Table 6, the lower values respectively, corresponding to the same sample numbers. These figures speak for themselves.

TABLE 7

Quantitative Determination for Adulteration of Check Samples Made Up by the Western Plant in Proportion as Those Assumed by the Eastern Plant Samples.

1	2	3	4	5	6	7	8	9
No. of Samples and order in which they were tested.	Western Plant Made Samples		R. T. O. Determ. in Terms of		Av. % O.B.M. & F.	% A. O. Samples by test. 100—Col. 6	% Error in A. O. Col 2 and Col. 7	% Error In A.O. for Samples sent by Eastern Plant, had they been as assumed. Col. 5, Table 6 Col. 7 & Table 7
	% A.O.	% R.T.O. 100%—Col. 2	% O.B.M.	% F.				
2	7.5	92.5	91.99	89.48	90.74	9.26	+1.76	+15.29
7	17.0	83.0	80.79	82.04	81.42	18.58	+1.58	+67.21
4	61.0	39.0	39.47	42.65	41.03	58.97	—2.03	—30.66
6	83.0	17.0	21.95	20.70	21.33	78.67	—4.33	—16.87
5	3.5	96.5	101.33	100.12	100.73	+0.73	+4.23	+47.09
3	22.5	77.5	68.92	71.45	70.24	29.76	+7.26	+12.35
1	37.0	63.0	58.72	50.58	54.65	45.35	+8.35	—23.21

Accuracy required by company: 5% to 10%.

ABBREVIATIONS:

R. T. O.—Refinery Oil Treated with Oil Brown M. and Phenolphthalein-Hexalin Identifier.
A. O.—Oil used as Adulterant.
O. B. M.—Oil Brown M.
F.—Phenolphthalein.

TABLE 6

Quantitative Determination for Adulteration Submitted by Eastern Plant.

1	2	3	4	5	6	7
Sample No.	Percent of R. T. O. as Determined in Terms of		Av. % of O. B. M. and F.	% A. O. in Samples 100%—Col. 4	% R. T. O. present in Samples in closest whole No.'s	% A. O. present in Samples in closest whole No.'s
	% O. B. M.	% F.				
1	84.79	87.27	86.03	13.97	85	15
2	77.49	76.92	77.21	22.79	75	25
3	64.66	65.60	65.13	34.87	65	35
4	68.68	70.63	69.66	30.34	70	30
5	49.65	49.17	49.41	50.59	50	50
6	34.25	33.48	33.87	66.13	36	65
7	15.32	16.26	15.79	84.21	15	85

Accuracy required by company: 5% to 10%.

ABBREVIATIONS:

A. O.—Oil used as Adulterant.
O. B. M.—Oil Brown M.
F.—Phenolphthalein.
R. T. O.—Refinery Oil Treated with Oil Brown M. and Phenolphthalein-Hexalin Identifier.

Taking the "If" From Oil-Finding

It took five years of profit and ten of science to make the search for new pools more definite

By CAMPBELL OSBORN

DURING the first 15 years of the twentieth century there were only five major oil pools in America that produced more than 100,000 bbl. daily.

Between 1915 and 1927 fifteen major pools were brought to their peaks and all but two were found in that period. Apparently something had happened to oil-finding.

It is generally conceded by oil men that their losses of the past ten years were caused by the finding of unneeded pools, but many think that the stimulus of price had little to do with the discovery of these pools. Though science is given some credit by nearly all, a few think that chance had more to do with it.

Some men blame the pipe line and crude oil marketing companies for low prices. Others charge the depression. And to many imported oil is the culprit.

Even proration, politics, and conservation have not escaped condemnation.

Seldom has the attention of petroleum executives been directed to a more controversial or a more important question.

Each of us is entitled to his own personal views. None can be sure that his solution is correct. Yet if like losses are to be avoided in the years to come every oil man must study this question carefully from all angles and answer it to his own satisfaction and to the best of his ability.

Numerous and varied as are the views of oil men on this subject, there is one common ground upon which they meet. All know that during the past decade the consumption of oil has grown. It could not have been lack of demand that vexed and harassed them. As the price has been low, the losses must, therefore, have been due to trouble with the supply, and most agree that somewhere, someway, somehow, in the unprecedented oversupply that began in 1927 lies the root of the evil.

But exactly where, when, and how, have not been decisively answered. Did the oil prices that preceded 1927 have anything to do with it? Are relations of demand and supply and their effect upon price, and the influence of price upon production, back in those years, worthy of scrutiny to see whether they provide any new ideas? Price history has a habit of repeating itself. What was it that so greatly stimulated production? What part did the geologist and the geophysicist play in the rehearsals that preceded this almost tragic drama? Can economics contribute anything? Let's carefully look over the period before the oil flood came and see if it yields any new facts and principles to guide the oil man away from another such disaster. And in doing this let us first get down to fundamentals.

Dominance of the Demand

The dominating influence in the oil business is the demand for products of petroleum *by consumers*. At times the demand for crude petroleum *by refiners* has caused increases in the price of this raw material. But studies of these gains show that crude oil price structures based on the purchase of petroleum by refiners and its manufacture into products in larger quantites than the public needed are not sustained. Such changes are premature and down must go the price when refined oils pile up in tanks and the demand for crude oil slackens.

Time was when the oil man and economist had to make their own calculations of demand. When stocks dropped they added the change to the figures on new supply; and when stored oil rose the gains were subtracted; but that trouble is no longer necessary, for the figures are now digested by governmental agencies and trade associations and served to the oil man in usable form.

Importance of the New Supply

The most helpful broad study the oil man can make in price analysis is the relation between this demand and the new supply. Needed supply data consist of current crude oil and natural-gas-gasoline production, and imports of crude and refined oils. In prorated pools this must be amplified with full information regarding potential production.

Prior to 1918 statistics of production were not available. The writer well remembers his efforts at that time to assemble the first current figures for the use of oil men. He was employed by the United States Geological Survey. The latest information was three years old. No law supported the undertaking. The oil men had to be visited and their confidence gained. Executives of the old school dominated the industry and some felt that no good would come to them by giving the government their figures. Reluctantly some sent them in pencil under personal covers. But at length all joined in the undertaking.

Today, as oil men know, government and industry alike publish complete current information on both new and old supplies. Stocks, too, though lesser in importance than production, are a significant price factor.

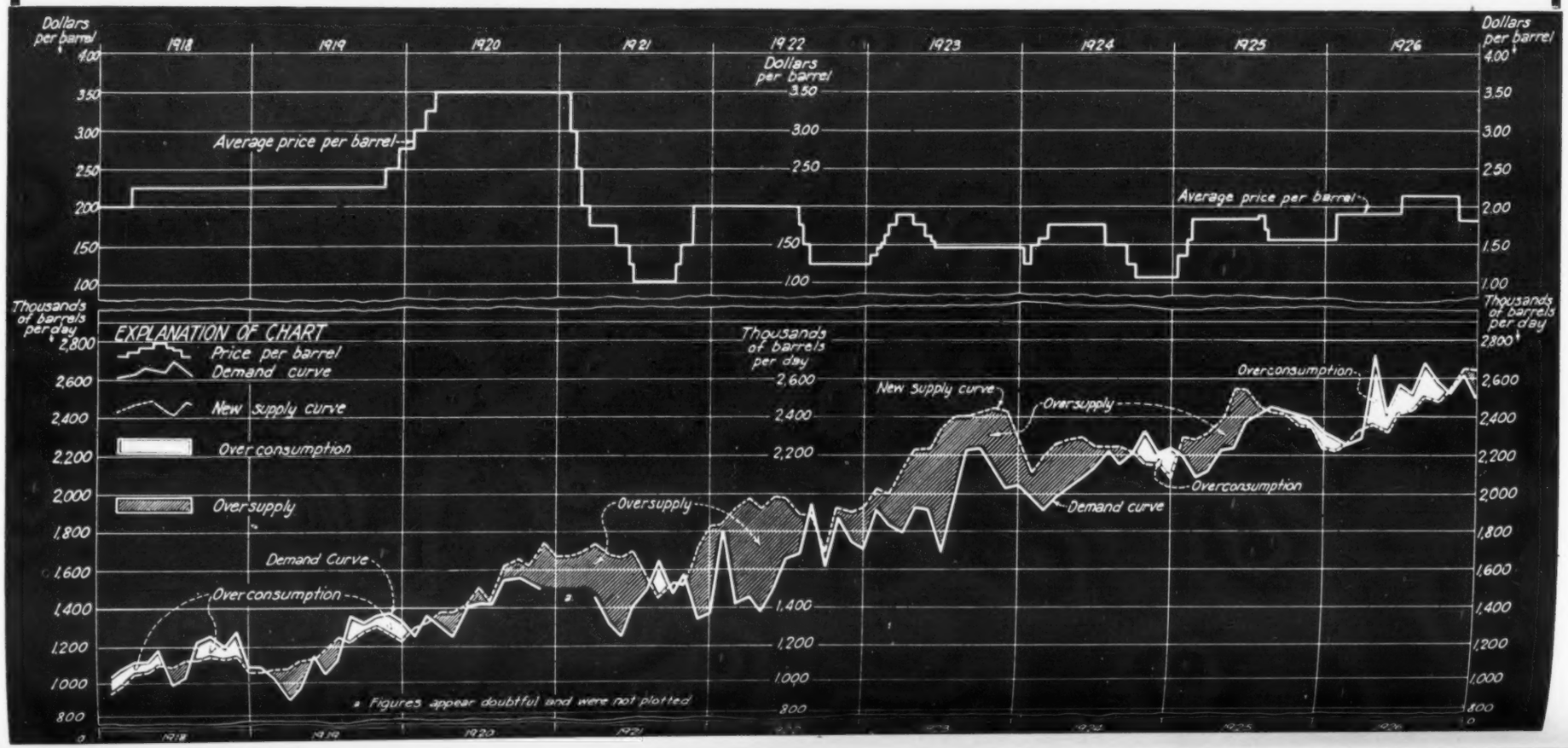
What the Data Show

To men who have been in this industry for 20 years little that is new could be presented concerning the amount of oil that went into storage and came out of it between 1917 and 1927; but reviewing it and comparing drilling activity and prices during the same period may give them some new thoughts.

Examine the accompanying chart of some of these things and what do you see? All know that in the years just preceding 1921 stocks were low. They were lower than they are today.

Look to the left of the illustration as far back as you can go and it will be seen that for three years demand and supply were well balanced. Consumption grew steadily and surely. There was overconsumption in one

Oil Demand, Supply, and Prices



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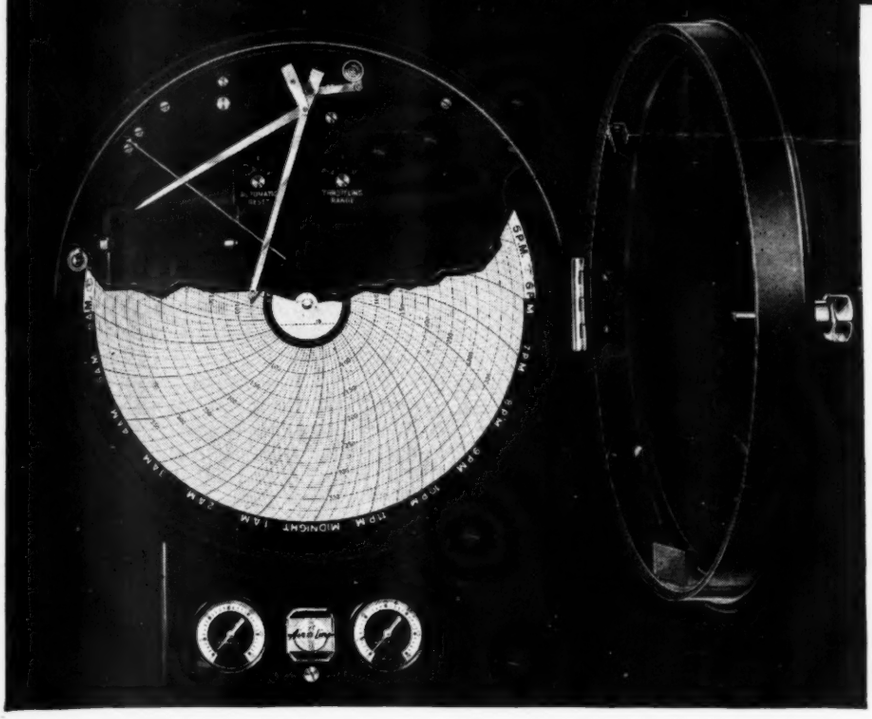

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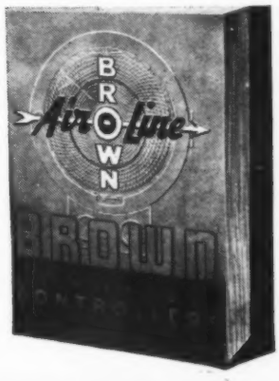


BROWN AIR OPERATED CONTROLLERS

OUTSTANDING PERFORMANCE WITH SIMPLICITY

year and stocks of course were reduced.

Few geologists or oil men at that time could see more than ten billion barrels for the future. There was little potential production upon which to call. Salt Creek was stable. Eldorado had reached a peak of 100,000 bbl. per day in 1917. Burkburnett had been discovered in 1918 and Santa Fe Springs in 1919. But these pools were lost in the general decline of older production.

The average price of Mid-Continent crude petroleum rose from $2.00 to $3.50 per barrel. For a while $6.00 was paid in Pennsylvania. Profits were abundant in these three fat years. For the first time a few executives employed economists, but most oil men paid little attention to their work and recommendations. The majority of the industry looked upon this expense as extravagance. It was premature they said, but the cost was small and profits could stand it at that time. These were good days indeed for the oil operator.

Geology Comes Into Its Own

The acquisitive instinct of the oil industry was not satisfied, however. That is not the way of human nature. The country had been calling for oil. Famine had been the gossip. Money talked, and the rythmic thud of cable tools soon spread to areas scoffed at by oil men of the older generation. With three years of profits new drilling had been doubled; however, this was not half the story.

Before science was applied to oil prospecting market-breaking fields were found occasionally by Barnsdall, the elder Donnell, and other similar wildcatters. Far apart, however, was usually spread their discovery. Many years ago Donnell, then head of the Ohio Oil Company, said that he had drilled thousands of wells and that he and others had produced all the oil the country needed with their methods. Be that as it may, old-fashioned methods would not have yielded the pools that were soon to be discovered. So many of them could not have been found by intuition.

The test wells for the new fields in the offing were not drilled on "creek-ology." Many years earlier White of West Virginia had told oil men that underground conditions could be mapped from surface outcrops, that oil occurred in upfolds of bedded rocks. Some of the progressive companies had taken him seriously. Courses in petroleum geology had been added to the curricula of universities and hundreds of the graduates got jobs. Later, core-drilling and new theories of petroleum accumulation added to their information. Mexia, Powell, Wortham, and the Panhandle, of Texas; Tonkawa and Burbank, of Oklahoma; Smackover, of Arkansas; and Huntington Beach, Santa Fe Springs, Long Beach, and Inglewood, of California, all major pools, were entered in the producing column. Though, then as now, it took the drill to tell the story, can it logically be said that the quick, successive discovery of these fields between 1917 and 1926 was not due to science and to the oil profits that paid for it? And could it reasonably be expected that what the scientists learned would be forgotten?

Look again at our picture and this time near the center. Several years had elapsed. Augmented by this flush production supply had outstripped demand. Though not abolished, geological forces were soon cut down. Downward also had gone the prices. Soon disappeared much, and in some companies all, of production's current profits. Back went the drilling rate also to where it had been. But the scientist and drill already had done their deadly work and the pools kept coming in.

For five years the surplus oil was run to tanks. The refiner was not scared. Consumption had gone up apace. At zigzagged prices from $1.00 to $2.00 per bbl. stored oil was more than doubled. By 1925 the search had temporarily run its course.

The Calm Before the Storm

Look once more at our chart of the course of oil and what does it show at the right? No new major pool was discovered in 1925. True, Smackover, Wortham, and Inglewood reached their peaks in that year, but by midsummer consumption had passed production, and until fateful 1927 oil came out of tanks.

Again the average price of crude oil rose, bringing profits to the better producer, but this time it stopped at $2.13 per barrel. Upward again also went the drilling rate, though not so high as in 1920. Science remembered what it learned, and again the scientist was put to work, and less wildcat tests were necessary than formerly to find the great series of new pools in which lurked the impending deluge.

Both the oil producer and science were again stimulated, and a second time something new was brought to oil-finding. It was geophysics. It had been shown that the seismograph could be used to map ocean bottoms and record natural earth tremors. Why could not subsurface rock formations be artificially vibrated and their position determined? Why could not physical science be made an ally of geology? It was done.

The magnetometer, torsion balance, gravity station, pendulum, whatever you want to call them, and other devices, followed. The supply of physicists was inadequate. Many were imported and most of them came from Germany.

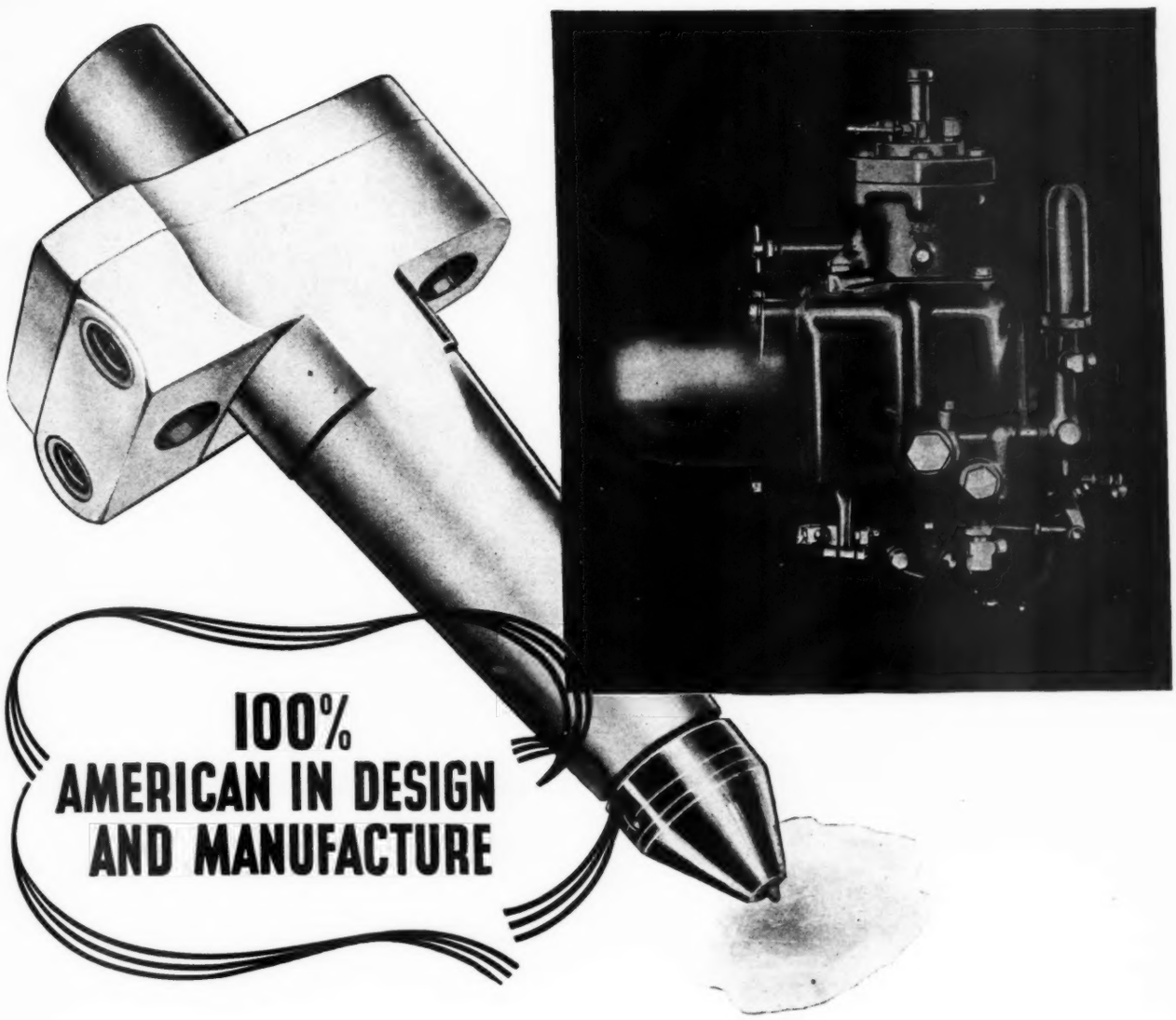
It has been said that in Barnsdall's day, when wells were located with old methods, the chance of discovery on a given piece of possible oil land was one to a thousand or more. Later, but before the wide use of the most improved methods, studies of wildcatting indicated that at least 200 tests had to be drilled for each pool discovered. With the best new methods used between 1916 and 1926 the odds were reduced to a ratio of perhaps one to ten or less. Even science was stimulated by money. Oil-finding had been revolutionized by five years of profit and ten of scientific research. Gasoline recovery may have been doubled with cracking, but since 1916 there had perhaps been an improvement of several hundred percent in exploration. Unquestionably the search for new pools was more definite. Is it surprising then that there were more major discoveries, and with fewer tests, in the decade just before the depression, than in all preceding years? It is not. With the information that had been assembled was it reasonable to expect the abrupt termination of these great finds? It was not. What scientists found in 1926—Seminole, Hendricks, and Yates—and what they were yet to discover in the next few years, will not be forgotten by oil men of this generation.

What Conclusions May Be Drawn?

There can be little doubt that the better oil companies made money much of the time between 1916 and 1927. Though costs are higher now, there was some profit for many producers then at a base price of $1.50 per bbl. for oil of average gravity; good profits at $2.00 and $3.50 per barrel. Drilling, finding, and production thus were stimulated. True enough, between 1920 and 1926, stocks were more than doubled, but did not demand increase also more than 100 percent? Looking back over the ten-year period under consideration what do the facts show, what helpful principles can be drawn?

There will be many points on which oil men agree. In the writer's judgment, the data show that the greatest force at work in the oil situation is the law of demand and supply. It is a more or less intangible thing, but its influence is felt in all competitive industries. Because of human factors and other temporary modifying conditions, its effect is often difficult to trace.

According to this law a persistent, substantially excessive supply ultimately lowers the price. On the other



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hand, overconsumption inevitably increases the price. If this law is not recognized by management, demand and supply correctly interpreted, and prices accordingly handled, competition intervenes, and the situation created by inaccurate collective business judgment is corrected. And the oil man pays the bill.

Demand and supply necessarily vary and accordingly the movement of prices is sometimes upward in excess of cost and at others downward and below cost.

Intangible as it may be and at times inoperative as it may seem, this law is constantly at work.

If there is substantial overproduction it continues until price reductions are made.

The economic effect of surplus potential production is partially equivalent to actual output.

The sharpness and rapidity of the reduction depend upon the intensity of the oversupply and the level of prices at the time oversupply begins.

A drastic reduction in price will correct oversupply sooner than a mild decline.

Low prices stimulate consumption, thus tending to correct the unbalanced situation.

If, during overconsumption, prices rise gradually, rather than abruptly, the period of shortage is longer.

High prices retard consumption, tending in this way to bring it in equilibrium with supply.

There is no regularity to the duration of either shortage or oversupply. It depends upon the character of the production, the nature of the demand, and the way prices are handled.

In the language of oil this economic law may be summarized thus: Mounting or strong prices stimulate leasing, drilling, and finding, increase production and refining, and reduce consumption; falling or low prices retard leasing and drilling, speed up lease abandonment, curtail geological work, reduce production and refining, and stimulate consumption.

Human factors and other influences are subordinate to the law of demand and supply.

The crude oil purchasing companies are managed by men subject to human errors of judgment.

Prices sometimes may be increased to avoid a feared shortage. If the threat is real it is thereby removed.

The natural human desire for profit must not be forgotten.

Large production from new fields may persist at length, regardless of a general price level below costs. The flush production costs may be low and the owners of the wells may feel that they can afford to sell their oil at a small margin of profit irrespective of general conditions.

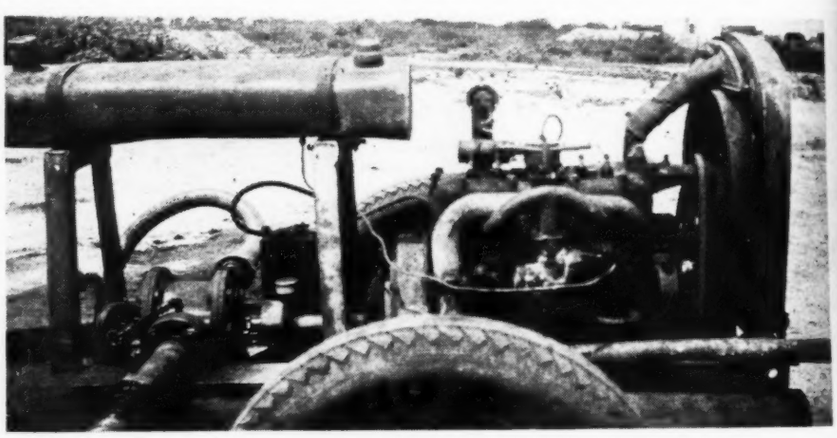
Demoralizing as its effects sometimes have been, the rank and file of the oil men have fared better under the law of demand and supply than during the preceding period of monopoly.

The last year of the period here reviewed was 1926. It was a profitable but inauspicious year. Prices were up until close to its end. There was nothing wrong with demand. The efficient companies had no grounds for complaint. Drilling had been stimulated by something. Presumably it was profits. Though there was still much "if" in oil finding, the geologist had improved his ability to locate favorable structures. No one knew what the new geophysics could do. It had shown great possibilities. It remained for time to show whether science and the drill were needed as much as many oil men believed they were at that time.

These are no idle conclusions or mere theories. They are in accord with the historical facts of the industry. The movements of demand, supply, and price sustain them; and what happened in succeeding years confirms them.

Portable Pipe Line Pump

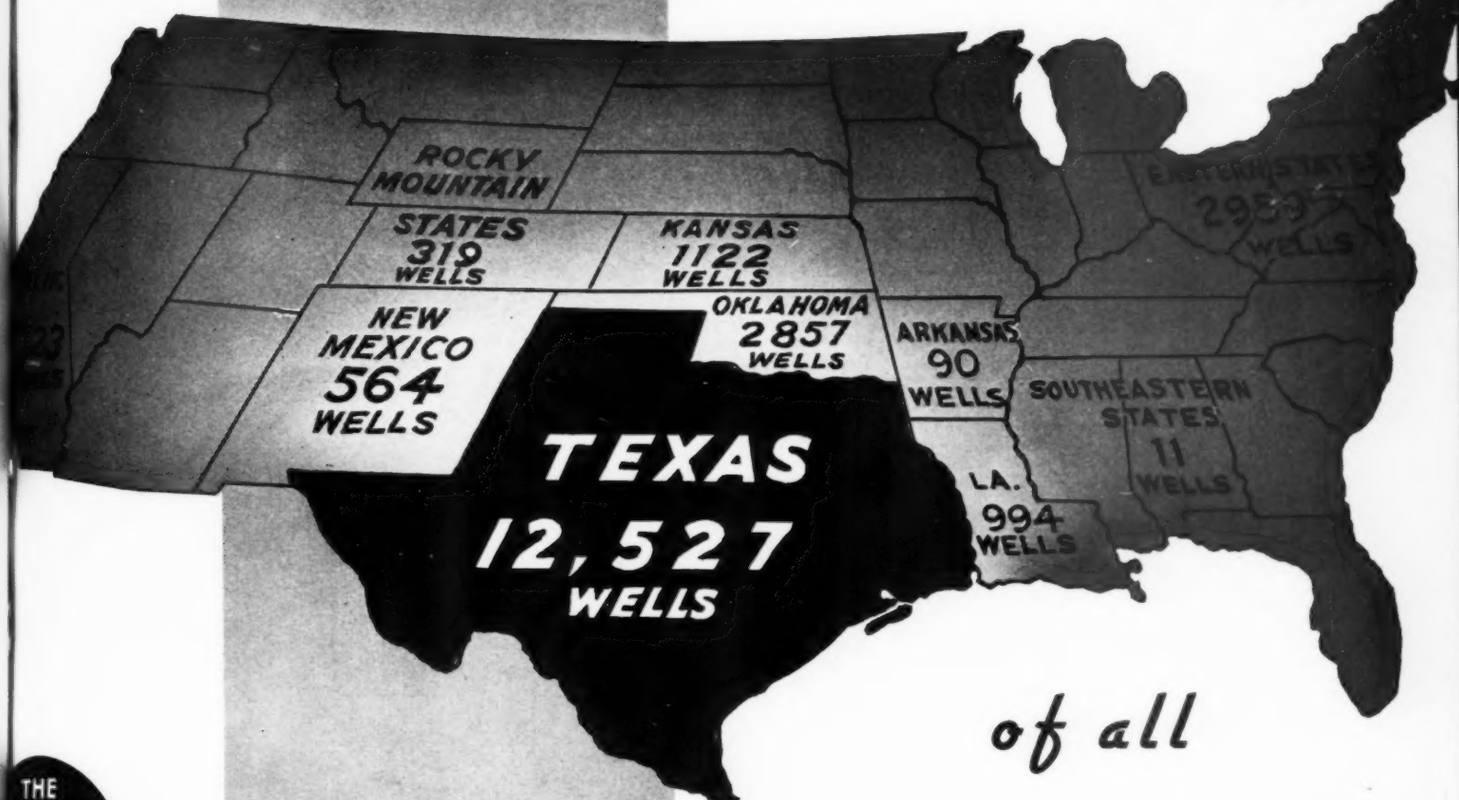
A PORTABLE pipe line pump mounted on an automobile trailer chassis is being used very effectively by the Valley Pipe Line Company in the Sam Fordyce field, southeastern Starr County, Texas. It is employed to pump crude oil into the gathering lines from lease tanks and is readily moved from place to place as needed. Gasoline is the fuel used, as would be expected, and the gasoline tank can be seen mounted overhead.



Upper photograph — Side view of portable pipe line pump used in Sam Fordyce field, Starr County, Texas, by Valley Pipe Line Company. Note the detail on the pump and hose connections

Lower photograph—Oblique view of the same equipment

TEXAS DRILLED 54%



of all

U. S. WELLS in 1936

(See Oil Weekly, January 11, 1937, Page 10)

Here in Texas, where more than one-half of the entire nation's drilling activity was centered in 1936, the Oil Industry's Key Men from around the world will gather for one week this fall to study and select equipment necessary for their coming year's operations.

This Industry Owned and **Operated Exposition** will present, in the new $1,337,000.00 exhibition hall, one of the finest parades of oil tools ever assembled. America's leading equipment manufacturers and distributors are already planning their exhibits for the world's leading buyers who, for this one occasion of the year, will be calling on the salesmen.

THE only OIL SHOW in 1937

One SHOW EVERY 2 YEARS

the Industry's *Oil Show* in *Houston* OCT. 11-16 will be held in the heart of the industry's *Activity!*

For Full Details Address:

Ed Lenzner, General Manager

OIL-WORLD EXPOSITION, INC.

Petroleum Building

HOUSTON, TEXAS

Running Tour
WITH MEN IN THE INDUSTRY

FRED K. HASKELL, Bartlesville, Oklahoma, who has been connected with the Empire organization for approximately 20 years, has resigned and will move to San Antonio, Texas, to become an independent operator in the Southwest Texas area. Haskell, at the time of his resignation, was manager of the Empire Pipe Line Company, a director of the Texas-Empire Pipe Line Company, vice-president of the Kaw Pipe Line Company and the Texas-Empire Pipe Line Company of Texas.

CHARLES B. McCLINTOCK, petroleum engineer of Oil City, Pennsylvania, recently spent considerable time in the fields of Wyoming and Colorado on business.

J. C. GALLAGHER, who is stationed in the Burma, India, field for the Pyinma Development Company, is visiting in the United States.

HAROLD C. MILLER, of the San Francisco office of the U. S. Bureau of Mines, was a visitor in Texas and the Mid-Continent in early March.

THOMAS H. SHERMAN, who for the past six years has been assistant general manager and chief of the engineering and statistical department of Oil Producers Agency of California, has resigned to become associated with **E. B. MILBURN** and **H. R. HAMILTON,** well-known Los Angeles oil operators.

GEORGE H. BAIRD, general superintendent of the natural gas division, has been made manager of the Cities Service Gas Company, according to an announcement by **H. R. STRAIGHT,** vice-president and general manager of the Empire Companies. Promotion of **A. N. HORNE** to the post of manager of Empire's pipe line division to succeed **FRED K. HASKELL,** resigned, also was announced. Horne has been general superintendent of the division. **W. A. FISHER** is the new assistant manager of the pipe line division.

COLIN REITH has returned from Bahrein in the Persian Gulf to headquarters of the Standard Oil Company of California at San Francisco.

C. B. DONOVAN, who has been with the Oil Well Supply Company at Hobbs, New Mexico, has joined the staff of the Carter Oil Company and will be in charge of drilling equipment.

CARL FRYER, analytical chemist at the Muskogee, Oklahoma, refinery of the Pure Oil Company, has been transferred to the Smiths Bluff, Texas, refinery of the company. **FRANK CLEGG,** chief tester at Muskogee, has been sent to Cabin Creek, West Virginia.

ARNOLD C. DAHL, of the engineering staff of the Shell Petroleum Corporation, has been transferred from Greenwich, Kansas, to Pampa, Texas.

FOSTER B. MOORE, engineer with the Shell Petroleum Corporation, has been transferred from Saginaw, Michigan, to Nowata, Oklahoma, where he will be in charge of operations. **JOSEPH CHALMERS,** petroleum engineer with the company in Texas, has been sent to the Netherlands. His headquarters will be The Hague.

J. B. BROYLES, farm boss for the Empire Oil and Refining Company, has been transferred from the North Texas district to the Odessa district in West Texas.

ROSCOE E. McDOUGAL, warehouse foreman for the Carter Oil Company, has been transferred from the South Burbank field of Oklahoma to Oklahoma City.

EDWIN C. GARTMAN, subforeman for the Carter Oil Company in the Crescent, Oklahoma, pool, has been transferred to Oklahoma City, and **WILLIAM R. HALL,** subforeman, has been moved from Oklahoma City to Crescent.

JACK WOODWARD recently was added to the petroleum engineering staff of the Magnolia Petroleum Company. His duties will be in the West Texas-New Mexico district with headquarters at Kermit, Texas. He is a graduate of the petroleum engineering school of the University of Texas.

B. N. MOUSER recently was made production superintendent of Kansas for the Transwestern Oil Company.

C. J. HAAS has been placed in charge of operations in Illinois by the Adams-Louisiana Company, making his headquarters at Vandalia. He has been with the Rusk Oil and Refining Company at Overton, Texas.

RUDOLPH HARTMANN, production foreman for the Union Oil Company of California in the Valley Division, has been made foreman of the Coast Division. **T. R. TINKER,** assistant production foreman of the Valley Division, has been promoted to foreman. **LEWIS S. KELSEY,** formerly meter inspector, has been named assistant production foreman in the Dominguez district.

H. P. GRIMM, president of the Pacific Western Oil Corporation, has resigned and will organize a company to operate in the Mid-Continent and California areas. **W. G. SKELLY,** head of the Skelly Oil Company, Tulsa, Oklahoma, has been chosen to succeed Grimm.

C. W. FROOME is in charge of the recently-created mechanical equipment unit of the Union Company of California. According to the announcement, the department was created for the purpose of further efficiency and economy in the selection, purchase, installation, operation, and testing of equipment.

A. J. RUTHVEN-MURRAY, general manager of Kern Trinidad Oilfields, has been elected chairman of the Institute of Petroleum Technologists, Trinidad Branch, to succeed **H. V. LAVINGTON.**

E. A. WAHLSTROM, of Fort Worth, Texas, has been made chairman of an engineering committee that has been formed by leading operators in the new Goldsmith-Cummins-Scharbauer field in Ector County, Texas. The committee will have for its purpose the compiling and maintaining of accurate data in the field's development. Wahlstrom, during the last two years, has been division production engineer for the Fort Worth division of Stanolind Oil and Gas Company.

GARDNER-DENVER

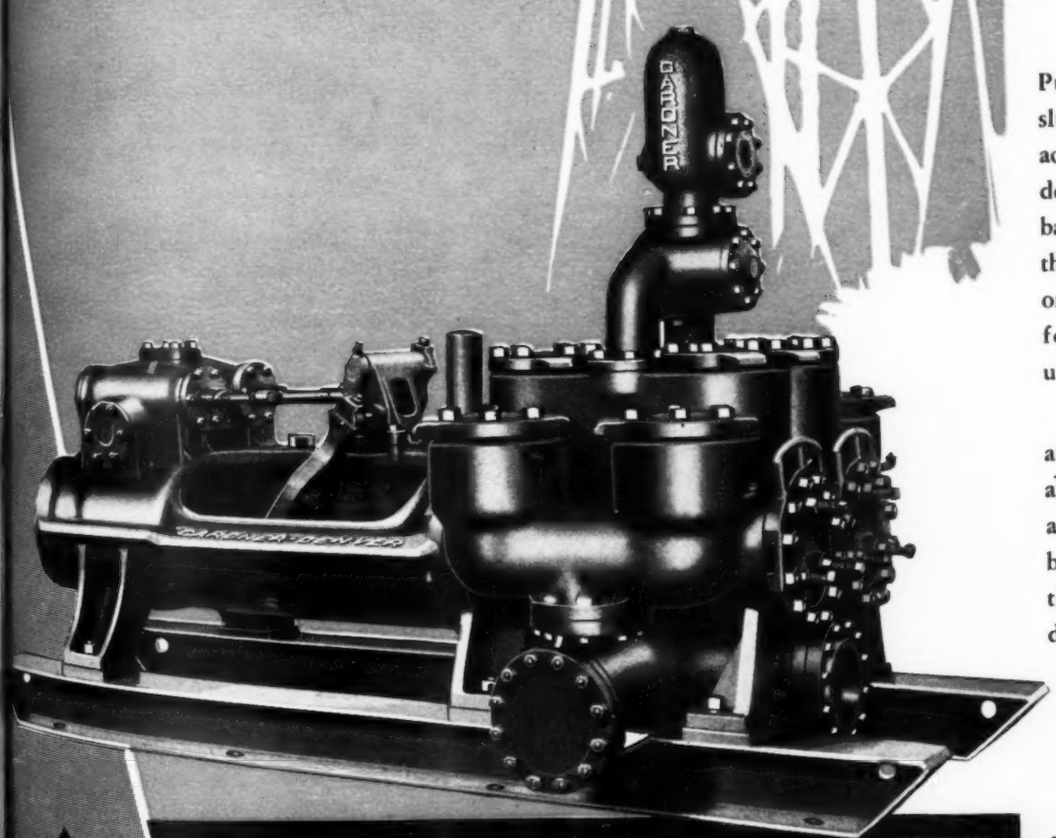
DUPLEX STEAM PUMPS

Challenge

The Toughest Jobs

Gardner-Denver Duplex Steam Pumps are designed to overcome slush pumps' worst enemy—abrasive action. With the divided fluid cylinder construction, there are no inner baffles or metal sections to be cut through by the mud. Nickel alloys or special hardening metals are used for all parts to insure long wear under exacting conditions.

Interchangeable cylinder liners and pistons make these pumps adaptable to widely varying conditions and needs. Taper fit rods, bronze bushed bearings, mechanical lubrication—all make for superiority of design and long, trouble-free service.



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LONDON PLOESTI
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Serving the Oil and Gas Industries

CONTINENTAL

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

"Hell, yes," said the devil, picking up the phone.—*University of South Mountain Goat.*

* * *

Mother: Freddie, have you seen your sister anywhere about?

Freddie: Yeah, she's out on the front porch naked.

Mother: Goodness, you scared me. For a minute I thought you said necking.

* * *

The doctor was visiting Rastus' wife to deliver her twelfth offspring. While riding along with Rastus he saw a duck in the road.

Doctor: Whose duck is that?

Rastus: That ain't no duck. That's the stork with his legs wore off.

* * *

"Is that a genuine bloodhound?"

"Sure—Oscar, come over here and bleed for the man!"

—*Washington Columns.*

* * *

"Does my gown look as though it were falling off my shoulders?"

"Naw, let's dance."

"I'm sorry, but I must go and rearrange it. It's supposed to look that way."

* * *

"Are you troubled with improper thoughts?"

"Naw, I enjoy them."

—*N. C. Wautaugan.*

* * *

"Darling, you're all the world to me."

"Well, don't think you're going to make any Cook's Tour tonight."

—*N. Y. U. Varieties.*

* * *

Wife: Did you object to the way I danced on the table?

Hubby: Yeah. How did you expect me to sleep with all that racket going on over my head?

—*Penn Punch Bowl.*

* * *

He'll Never Learn

"What's the matter up at Tom's house?"

"They're taking 'im away in the ambulance for beating 'is missus."

* * *

"And what was your husband doing while you were trying to sleep by counting sheep?"

"Pulling the wool over my eyes!"

"I can't give you a job. I can't afford any extra help just now."

"That's all right. I shan't be much help."

* * *

"How did you come out at the dog race? Did your dog win?"

"No, he was left at the post."

* * *

Of course you've heard the story of the relief client who was so accustomed after years of unemployment to having everything done for him that he went out and married a widow with three children.

* * *

Mandy: What would you do if I fainted?

Sam: Why, I'd resusicate you.

Mandy: If you did, you'd have to marry me.

* * *

"What did your wife say when you came home last night?"

"The darling never said a word. And I was going to have those two front teeth pulled out anyway."

* * *

Consultant

"Tell me, papa, what is a consulting physician?"

"He is a doctor who is called in at the last minute to share the blame."

* * *

The teacher had asked her class to write a short composition on the subject, "Water."

One scholar seemed to be having difficulty, but finally he turned in his paper, and here is what he wrote:

"Water is a light-colored, wet liquid which turns dark when you wash in it."

* * *

Wife: The new nurse is very scientific. She never lets anyone kiss the baby while she is around.

Husband: Who would want to?

* * *

"Before we were married," the better half said, "you always engaged a taxi when you took me anywhere. Now you seem to think the bus or trolley is good enough."

"No, my pet!" he replied, "I don't think the bus or trolley is good enough for you! It's because I'm so proud of you. In a taxi you would be seen by nobody save the driver, while I can show you off to so many people by taking you in the street car or bus!"

The new reporter wrote his concluding paragraph concerning the murder as follows:

"Fortunately for the deceased, he had deposited all his money in the bank the day before. He lost practicaly nothing but his life."

* * *

"Well, there's one thing to be said in radio's favor," began Morton.

"Really! What is it?"

"If you live in an apartment house you can tell what kind of neighbors you have by their sets."

"How come?"

"Easy. If they go for jazz, they are a peppy outfit; if they're fond of symphonies they're dead from the neck up; if they listen to political speeches they're nutty. But if they seldom turn the danged thing on, they're swell folks."

* * *

A Close Game

When men wore long beards—a wife allowed her husband to play poker twice a month while she had a party of lady friends. The husband came home one night while all were there, his whiskers loaded with tobacco juice.

Wife: Dear me, John, couldn't you turn your head to spit?

Husband: Nope, not in that game.

* * *

Chaplain: How could you have the heart to swindle people who trusted in you?

Prisoner: But, parson, people who don't trust you cannot be swindled.

* * *

Beggar: Will you let me have a dime, mister?

Sailor: I haven't any change on me, but I'll give it to you when I come back this way.

Beggar: Well, all right, but you'd be surprised at the money I lose giving credit this way.—*The Broadcaster.*

* * *

"Unfrock a lady and you may find raspberry-colored lingerie — or misty green or dull blue."—*Vogue.*

Or a slap in the face.

—*N. Y. U. Varieties.*

* * *

"Did you make that face at me?" roared the school mistress.

"No, ma'am," said the little boy, "you just happened to walk in front of it."

HOW'S YOUR I. Q.?

Here's a Good Way to Find Out, and at the Same Time

WIN A VALUABLE PRIZE!

Perhaps you already know the answers to most of the questions below, but if not there are plenty of clues given to help you win a useful prize. All answers can be found in the 1937 Composite Catalog, and in the Baker Catalog which we will gladly send to any oil man.

Any person employed in the Drilling or Production Branches of the Oil Industry is eligible. There is no entry fee—nothing to buy—no special knowledge is required. Just place a check mark opposite the answer you believe to be correct—or write your answer in the space provided. Then cut out this page along the dotted line and mail to the address below. Contest closes at midnight March 31, 1937, and no envelope postmarked after that time can be considered. You may win an extra prize for promptness—see details below.

For 20 Correct Answers You Can Win this Handsome Twin-Deck Set of Bridge Playing Cards.

For 18 or 19 Correct Answers you will Win this Attractive and Useful 5-foot Steel Tape in Nickeled Case—something you will use every day.

EXTRA PRIZES IF YOU ARE PROMPT

If you are one of the First 10 persons sending Correct Answers to all 20 Questions, not only will you receive the Twin Deck set of playing cards, but we will pack them in a handsome leather case with your name gold stamped on cover. It Will Pay you to Start Now, and to Spend Extra Time to Be Sure Your Answers are ALL Correct!

LIST OF CORRECT ANSWERS will be Published in the April, 1937, Issue of Petroleum Engineer. Send in your Answers promptly—then watch for this issue to check your I. Q.

Note: This contest is not open to persons residing in states where prize contests are not permitted by law. BUT IF YOU WANT TO TEST YOUR I. Q. go ahead and answer the questions and send in this page. WHETHER YOUR ANSWERS ARE RIGHT OR WRONG we will place your name on our list to receive for the rest of the year 1937 the little booklet called FRIENDLY CHAT, published monthly, which is full of stories, poems and quotations to give you a smile—to bring sunshine into dull days—to make you realize what friends should mean to you, and what your friendship means to others. This offer applies **only** if you live in a state whose laws ***will not permit you to compete for prizes.***

ALL READY? . . . HERE ARE THE QUESTIONS!

CUT OFF ON DOTTED LINE AND MAIL TODAY!

1. What large Supply Company is celebrating its 75th Anniversary in 1937?

.....

2. The valve in a "Bakwik" Drill Pipe Float . . .

.....screws into the body
.....is held in place by the tool joint pin
.....locks into a tee-slot

3. Baker Kelly Straighteners operate by

.....steam pressure
.....leverage on a crow bar
.....hydraulic pressure

4. If drill pipe has been twisted off in a cave, what Baker Oil Tool would you find useful?

.....

5. The valve assembly in a Baker Cement Float Shoe is made of . . .

.....concrete .....bakelite
.....cast iron .....brass

6. Name three important uses for the Baker Model F Cement Retainer . . .

a. .....
b. .....
c. .....

7. Cement can be directed upward around the shoe and casing by using a . . .

.....Baker Cable Tool Core Barrel
.....Baker Cement Dump Bailer
.....Baker Cement Whirler Float Shoe
.....Baker Yungling Spiral Guide

8. Cores taken from extremely hard formations with a Baker Cable Tool Core Barrel usually are recovered in what form or shape?

.....

9. What is the purpose of the rubber ring in a Baker Cement Float Collar?

.....

10. If plastered rotary mud prevents a well from coming in easily, what Baker Oil Tool do you need?

.....

11. One of the many successful uses of a Baker Cement Retainer is to . . .

.....enlarge the hole before cementing
.....guide the overshot when fishing
.....straighten drill pipe
.....perform squeeze jobs

12. This core was taken from the side wall of an open hole by using a . . .

.....Baker Cable Tool Core Barrel
.....Baker Wall Hook
.....Baker Wall Sampler
.....Baker Whirler Cementing Collar with Basket

13. What Baker Oil Tool is used to cut formation as shown in this illustration?

.....

14. If you want to retain cement "tailings" inside the casing, what one of these Baker Tools would you use?

.....Baker Cement Retainer
.....Baker Cement Float Collar
.....Bakwik Drill Pipe Float
.....Baker Cleanout Bailer

15. This material was drilled out of a Baker Cement Float Shoe; what is it?

.....

16. The minimum reaming size of a No. 3-A Baker Wall Scraper is 5¾"—what is its maximum reaming size?

.....inches.

17. The valve ball in a Baker Cement Whirler Float Shoe is made of . . .

.....rubber .....cement
.....bakelite .....wood

18. The Canvas Basket Assembly on a Baker Whirler Collar serves to . . .

.....prevent blowouts
.....scrape off rotary mud
.....protect lower oil sands from cement

19. Baker uses concrete in all equipment for guiding, floating and cementing casing, because it is . . .

.....easy to drill up and circulate out of the hole
.....stronger than cast iron
.....cheaper than alloy steel

20. What color concrete is furnished in Baker Cement Equipment to determine the presence in "returns" of material drilled out of the shoe or collar?

.....

BE SURE TO PRINT OR TYPE YOUR NAME AND ADDRESS PLAINLY

My name is.....

I work for the.....**Oil Company**

My position is.....

My street address.....

City.....**State or County**.....

Mail this to . . .

BAKER OIL TOOLS, INC.
P. O. Box 71
HUNTINGTON PARK, CALIFORNIA, U. S. A.

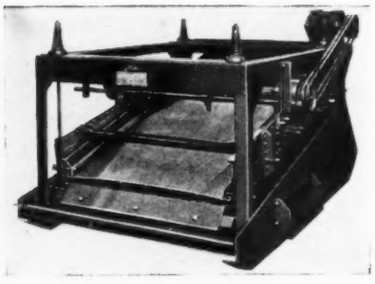
Remember that the correct answers will be published in the Petroleum Engineer of April, 1937—watch for it.

CUT OFF ON DOTTED LINE AND MAIL TODAY!

MACHINERY and EQUIPMENT

Mud Screen Improved

ALLIS-CHALMERS Manufacturing Company of Milwaukee, Wisconsin, has made improvements on its mud screen, or "shale shaker," for reclaiming and conditioning rotary drilling mud. The screen cloth of this mud screen is now made in two sections at different inclinations. This permits a cleaner separation of mud on the feed end section of the screen and a more



rapid discharge of oversize material on the discharge end of the screen, the manufacturers state. A further improvement also has been made in the mud box, permitting more even distribution of the mud that is passed through the screen cloth. Otherwise the screen, as heretofore, is suspended from springs mounted on a frame that incorporates a complete unit consisting of feed box for either flow pipe or trough connection, motor or turbine mounting, or both, mud box with spout for screened mud, and substantial skids for easy handling. The angle of the screening deck is easily adjustable while the screen is running. This mud screen is of high capacity, with long life screen cloth, and may be set up, or moved to a new location with minimum labor and expense, it is stated.

Compartment Manifold Features Interlocking Operation

THE Ralph N. Brodie Company recently added a new selector manifold to its meter accessory equipment. Selective compartment control has many advantages for tank-trucks hauling gasoline or fuel oil, the manufacturers state. The selector unit is made for trucks having from two to six separate compartments. The inerlocking mechanism of the Brodie Selector Manifold prevents opening of more than one compartment at a time. Its use prevents accidental opening of compartments and also eliminates drawing of air through metering equipment from an empty compartment, it is stated. More compact piping arrangements are said to be another advantage and the use of special welded manifolds, fittings, and separate valves are made unnecessary. An illustrated bulletin may be obtained from the manufacturer, 971 61st Stret, Oakland, California.

National Beam and Post Assemblies

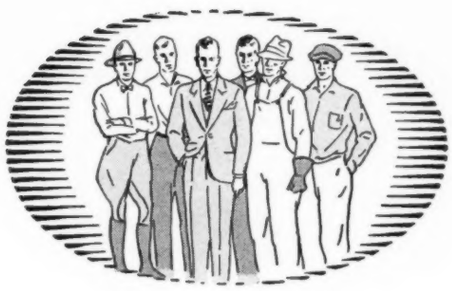
THE National Supply Company, Toledo, Ohio, has announced the addition of two new models to its line of beam and post assemblies. These are known as types SH-201 and SH-801. A series of four sizes is now available to cover the complete range of pumping requirements.

National beam and post assemblies are used for pumping either single or multiple wells through back-crank attachments. They are designed for installation on a concrete base and are adapted to reduction gears or standard rig cranks and crankshaft.

The type SH-801 National beam and post assembly has a rated polished rod stroke of 72 in. and an A.P.I. rated load capacity of walking beam of 22,700 pounds. It is of the long beam working center design. This type makes possible the use of a single bearing beam hanger of great simplicity and durability. In addition it may be installed without interfering with the derrick or cellar as the beam is long enough to clear the derrick floor.

The type SH-201 National beam and post assembly represents the smallest size of the line. It has a rated polished rod stroke of 37½ in. and an A.P.I. rated load capacity of walking beam of 9000 pounds. It differs from the three larger sizes in having an extended beam to receive beam counterweights.

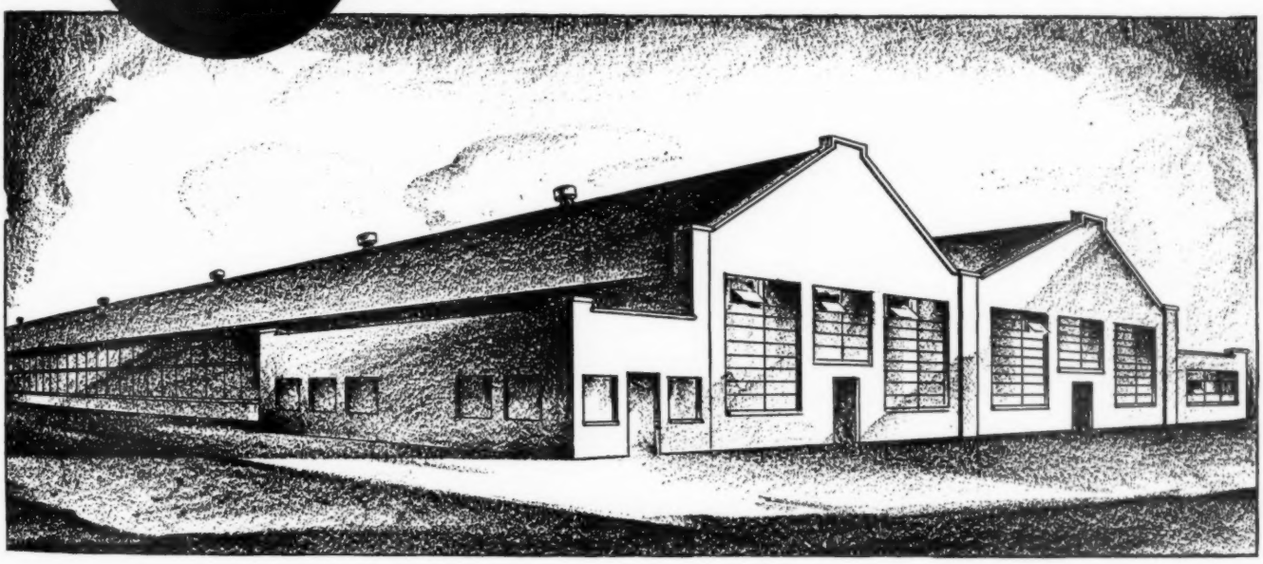
YOU BUILT THIS PLANT



You who demand the ultimate in oil well pump and sucker rod development—you who appreciate the value of consistent service—you who look to the leaders for leadership—it is you who have made Axelson's newest expansion of service and manufacturing facilities a reality. On February 1st the reconstruction on Axelson's St. Louis plant was completed, doubling the size and capacity. In this plant are installed the most modern of heat-treating furnaces—the most accurate of machine tool equipment. New laboratory facilities, new testing and checking devices, make this factory second to none in the industry. Steadfastly adhering to a policy laid down 45 years ago, Axelson has invested hundreds of thousands of dollars to enable them to keep one step ahead of industry's demands. From machinist to executive, Axelson's policy continues to be "Service Begets Sales."

AXELSON SUCKER RODS ARE HEAT TREATED FROM END TO END

Axelson's St. Louis plant has installed furnaces and equipment which makes possible the heat treating of sucker rods from end to end.



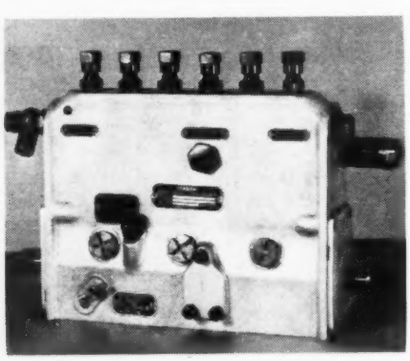
Axelson Manufacturing Company, P. O. Box 710, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa
Mid-Continent and Eastern Distributor: Frick-Reid Supply Corp. • *Rocky Mountain Distributor:* Great Northern Tool & Supply Co.

DEEP WELL PLUNGER PUMPS **AXELSON** SUCKER RODS

Timken Fuel Injection Pump for Diesel Engines

THE Timken Roller Bearing Company, Canton, Ohio, announces a high-speed solid-injection fuel pump for Diesel engines, manufactured in two sizes, one using a 4-9 mm. range of plunger sizes and the other a 5-11 mm. range. At present these pumps are being made for 1-, 2-, and 6-cylinder engines.

The pumps are of the cam-operated helical-plunger type, the metering being adjusted at the factory and sealed. At the lowest position of the plunger the cylinder receives a charge of oil from the feed line, which is kept filled by a special feed pump connected to the fuel tank. Delivery of the fuel to the engine starts as soon as the piston covers the inlet port and ends when



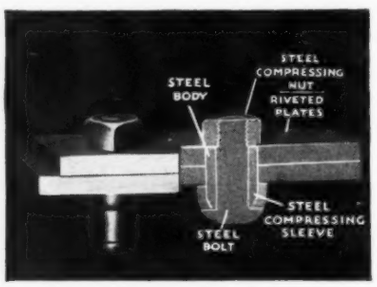
the upper helical edge of the annular groove in the piston opens the overflow or by-pass port on the opposite side of the pump cylinder wall, releasing the pressure to the discharge line. The effective delivery stroke of the piston may be regulated by turning the piston in its cylinder or barrel to vary the point of the delivery stroke in which the overflow port is uncovered.

A feature of these pumps is that they are driven by constant velocity cams. Thus the delivery speed of the fuel entering the combustion chamber of the engine is maintained constant at a speed adapted to the rate of combusiton. The deceleration portion of the motion comes late in the stroke, thus permitting the use of a lighter spring and reducing the spring load between the tappet and the cam.

Front Drive Rivets

THE Front Drive Rivet is constructed of a hardened steel body with horizontal cutting ribs, through which a special steel bolt passes. A steel compressing sleeve is placed on the taper of the body and held by the bolt head. The compressing nut locks the assembly together.

The Multi-Seal Front Drive Rivet can be put in at the rate of five per



minute, using an ordinary electric nut runner; they also can be operated with an ordinary wrench, by one operator, the manufacturers state.

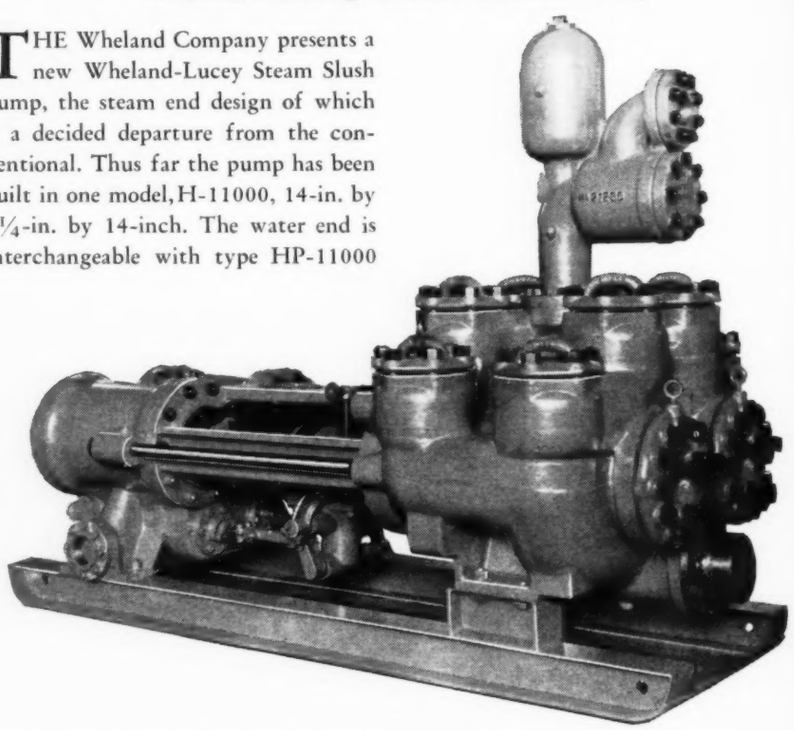
The Front Drive Rivet is driven in the hole and the hex nut drawn up with a wrench or nut runner. The steel compressing sleeve is drawn down over the shank and forms a steel rivet, sealing head on the inside or blind side of the job, leaving only a hex nut on the outside. Fancy or decorative nuts or caps for finished appearance are available.

These rivets are valuable, the manufacturers point out, wherever it is impossible, expensive, or inconvenient to work from both sides of the job, such as tanks, pipes, compressors, machinery, etc., where repairs or assembly can only be made from the outside. The rivet has the strength of the ordinary bolt or rivet, it is stated.

They are manufactured by the Multi-Seal Manufacturing Corporation, Chicago, Illinois.

Wheland-Lucey Steam Slush Pump

THE Wheland Company presents a new Wheland-Lucey Steam Slush Pump, the steam end design of which is a decided departure from the conventional. Thus far the pump has been built in one model, H-11000, 14-in. by 7¼-in. by 14-inch. The water end is interchangeable with type HP-11000



7¼-in. by 14-in. power pump and is tested to 3000 pounds.

The steam end of the pump has been literally turned up-side-down with the valves below the cylinders, and rocker mechanism underneath the cradle.

Intake steam enters above and between the cylinders and passes down between the valves. Both steam and exhaust valves being situated below the cylinders, condensation drains freely through the exhaust. Since the cooled condensate is drained continuously, it does not come in contact with, and tend to cool, the fresh intake steam.

Advantages resulting are better steam cushion, increased mean effective pressure, and higher mud pressure, the manufacturers state.

Photograph above shows TRINITY "INFERNO" *on location in Rodessa Field.* (Photo by LeDOUX)

Oil Men Welcome TRINITY "INFERNO"

Sulphate Resisting Portland Cement

SLOW SETTING UNDER HIGH TEMPERATURE

● Oil men tell us that TRINITY "INFERNO" meets and exceeds every requirement of a "deep-well" cement . . . Sulphate Resisting and Slow Setting under High Temperatures, regardless of depth . . . Easy to Mix . . . Easy to get a Heavy Weight Slurry if desired . . . Desirable Fluidity, viscosity or pumpability . . . Rapid Hardening to give a high strength within one day. TRINITY "INFERNO" was not introduced until it had been perfected after exhaustive research and tests made at the request of leading oil companies in collaboration with their technical men . . . and that's why "INFERNO" is receiving such a hearty welcome from oil men.

Try "INFERNO" on *your* next "deep-well" job . . . then you'll *always* insist on "INFERNO" for the advantages it gives.

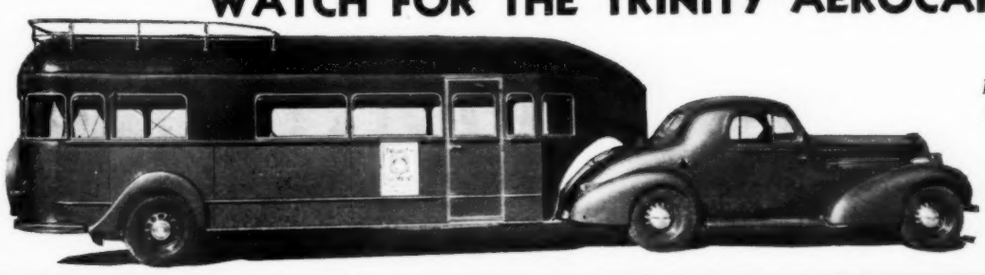
YOUR LOCAL DEALER CAN SUPPLY YOU

TRINITY PORTLAND CEMENT COMPANY

Manufacturers of Trinity Standard Portland Cement, Trinity "High Early Strength" Portland Cement and Trinity Mix Masonry Cement.

DALLAS ● FORT WORTH ● HOUSTON

WATCH FOR THE TRINITY AEROCAR!



In charge of one of Trinity's technical staff, our Aerocar is on tour of the oil fields. Watch for it!

Globe Type H Roller Bit

THE Globe Type H roller bit features strength and compactness. In its construction the "floating" yoke has been eliminated by making the inner supports on the gauge cutters integral with the body, and by fastening the center support for the inside cutters directly into the bit body by a threaded member. Thus, instead of the entire load on the cutters being carried

by the four outside fingers, each of the inside, as well as the outside, members contribute their share to the support of the cutter load, giving a strong and rigid assembly.

Another feature of the new Globe roller bit is the method of mounting the cutters on double ball races in such a manner that each cutter will carry heavy thrust loads from either, instead of but one, direction. This adds to the life of the bit by keeping the cutters in proper alignment under the most severe usage, the manufacturers state.

The cutters are generously hard-faced and are shaped to cut a high center in the bottom of the hole, thus guiding the bit and keeping the hole straight.

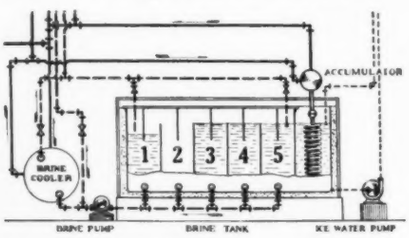
Additional information on this new bit can be obtained from the Globe Oil Tools Company, Los Nietos, California.

Carbondale Constant Temperature Brine Tank

AN unusual "constant temperature brine tank," shown in the accompanying sketch, has been developed by the Carbondale Division of Worthington Pump and Machinery Corporation, Harrison, New Jersey.

As shown in the accompanying sketch, the tank is divided into a number of compartments, marked 1, 2, 3, 4, and 5. These compartments are arranged in such a manner that the cold brine used for cooling is not affected by the warmer return brine. Cooling therefore is performed at its most effective and best rate at all times.

Only the lowest temperature brine is used for cooling, and without increase in initial temperature at any time. With compartments Nos. 1, 2, 3, and 4 full, consumption of brine begins from the compartment numbered 4—



compartment No. 5 being empty. The brine pumped from No. 4 returns into No. 5. As soon as No. 4 is emptied, brine is taken from No. 3—the warm return brine still returning to No. 5, which eventually fills up and overflows into No. 4. In other words, there is no mixing of the warm return brine with cold brine in any of the compartments.

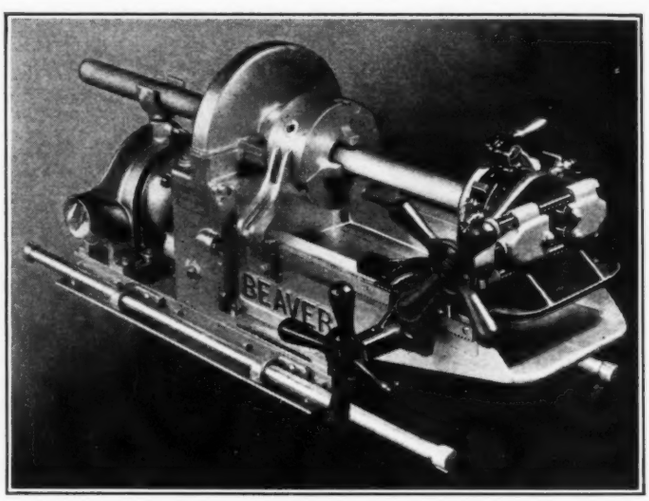
When No. 3 is emptied, consumption begins from No. 2, warm return brine still entering No. 5, overflowing to No. 4, and thence when No. 4 is full, to No. 3.

Eventually, when the process is ended, and consumption of cold brine ceases, compartment No. 1 is empty, and Nos. 2, 3, 4, and 5 are full of warmed brine, ready to be cooled over a relatively long period by the refrigerating machine.

In this way, as already stated, the brine being used for cooling is maintained at its lowest temperature because it is not affected in any way by the warmer return brine.

Heretofore, brine tanks employed for peak load cooling have been most effective during the early part of the cooling load, and least effective during the latter part, due to the increase in temperature of the brine caused by the intermingling of the warmer return brine with the originally cold brine. This simple new Carbondale method permits the cold brine to be equally effective over the entire cooling period, according to the manufacturers.

Special Pipe Machine of Beaver



THE new Model-A Special Pipe Machine of Beaver Pipe Tools, Inc., Warren, Ohio, shown in the accompanying illustration, is equipped with a wheel-and-roller cutoff and is manually fed. It is designed to cut pipe of ⅛ in. to 2 in. in diameter, and solid rods of $\frac{5}{16}$ in. to 1 inch. Threads are made on pipe of ⅛ in. to 2 in. diameter, and on bolts and rods of ¼ in. to 2 inch. With geared tools it will cut and thread pipe of 2½ in. to 12 in. diameter.

Outstanding features of the equipment are listed by the manufacturers as follows: (1) right handed; (2) all controls in front; (3) universal motor; (4) standard chuck; (5) automatic chuck wrench ejector; (6) inverted rack-and-pinion that thus protects against chips; (7) outboard pipe support prevents "whip" of long lengths of pipe; (8) dieheads are quick opening—not necessary to "back off"; (9) no "hinge"; (10) concealed oil lines; (11) oil pump conveniently placed; (12) gear driven; (13) an 8-fluted alloy tool-steel cone-type reamer swings in and out of working position and removes instantly all trace of burr. Touched to the outside edge of the pipe it chamfers; (14) sliding handle bars; (15) nickel iron housing.

MASONEILAN REGULATORS STAY ON THE JOB

Year after year, out in the field where shut-downs are particularly costly, Masoneilan Regulators are doing the work for which they are built — setting new standards of dependability.

The reason is that Masoneilan equipment is built up to the job—not down to a price. Correct design, highest quality materials and precision workmanship, backed by over half a century of practical experience insure Masoneilan equipment staying in the line and out of the repair shop.

Specify Masoneilan Regulators for gas, oil, water or steam service under all operating conditions. Write your requirements to our nearest office.

MASONEILAN

MASON-NEILAN REGULATOR COMPANY, 1193 ADAMS STREET, BOSTON, MASS., U. S. A.

New York Philadelphia Pittsburgh Chicago Tulsa St. Louis Houston Los Angeles

Cleveland Model 110 Trencher

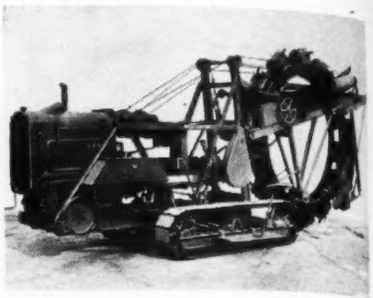
THE most recent addition to The Cleveland Trencher Company's line of trenching and ditching equipment is the Cleveland "Model 110." This model is constructed along the design of full crawler ditchers. The trench-cutting capacities are from 10½ in. to 23 in. wide and to a maximum of 5½ ft. in depth.

By simple lever-shifting, a multiplicity of digging and traction speeds, in combination with different wheel speeds, are instantly available to the operator, the manufacturers state. Digging speeds range from 1½ in. to 33 ft. per minute. The top road speed is three miles per hour.

Power is provided by a 325-cu. in. gasoline engine, developing 38.5 hp. at 1000 revolutions per minute.

Some of the features pointed out by the makers are: Unit type construction; steel-enclosed, dirt-sealed, drives; differential brake steering; quick-shift arc-type conveyor; close-up view of digging action from operator's platform; use of over 90 anti-friction bearings; unprecedented usage of alloy, heat-treated steels.

Wheel-mounted buckets of rigidly-mounted design do the digging. These



buckets, as well as all cutting units, are constructed to insure maximum digging capacity with minimum expenditure of power, it is stated. Special equipment handles the stickiest soils.

Ground bearing pressure is only 5.5 lb. per sq. in.; with auxiliary 16-in. cleats 4.3 lb. per sq. inch.

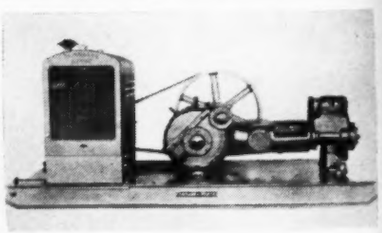
Easily-installed accessories simplify pipe-stripping for reconditioning or replacement, the makers say.

Fairbanks-Morse Pumping Units

A NEW line of pumping units for oil field service has been announced by Fairbanks, Morse & Company, Chicago, Illinois. These units consist of an F-M simplex or duplex self-oiling power pump mounted on a steel base with either an F-M multi-cylinder power unit, F-M Model 36 Diesel or F-M "Z" engine.

Six-inch stroke pumps, with interchangeable cylinders ranging in size from 2½ in. to 4 in., are driven through Flex-Mor V-belts by F-M 6-cylinder gas, gasoline, or combination gas and gasoline power units. These pumping units have capacities of 33 to 133 bbl. per hour with pressures from 270 to 500 pounds.

Four-inch stroke simplex and 4-in. to 10-in. stroke duplex pumps are available with gas or gasoline multi-cylinder power units, 4-cycle Diesels or "Z" gasoline, kerosene, or natural gas engines, offering a wide range of pump



sizes with various prime movers.

The sturdy bases, fabricated from steel "I" beams and plates, facilitate moving and contribute to better operation through protecting the equipment from dirt, the manufacturers state.

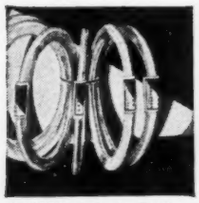
THE RIGHT PACKING in the Right Place!

J-M Sea Rings. Absolutely automatic. Save power. Reduce wear on equipment. Last longer.

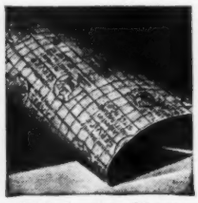
J-M Kearsarge Rod Packing. Retains its efficiency—note construction of center block.

J-M Centripac. Plaited construction. Specially designed for centrifugal service.

J-M Flax Packings available in various styles to meet a wide variety of service conditions.



J-M Kearsarge Boiler Gaskets assure a perfect seal on handholes, manholes and tube plates.



J-M Service Sheet. Pliable. Resilient. Adaptable to all general sheet packing purposes.

J-M Mogul Packing. An excellent utility packing for general service.

FOR *complete* information on J-M's *complete* line of packings for the oil industry, send for the J-M Packings Catalog. Address Johns-Manville, 22 East 40th St., New York City.

Johns-Manville PACKINGS

For Every Oil Industry Service

JM

FOREMOST IN DITCHER VALUE

Digs Anywhere Any Time
The CLEVELAND "MODEL 110"

Built to meet and conquer pipeline conditions as they are. A tough, fast, modern machine without needless bulk or weight.

Portable, economical and easy to handle, the "Model 110" widens the field of machine-ditching. Safeguards your investment.

Fifteen years of specialized progress plus a determination to use only the best in construction throughout have made "Clevelands" foremost in value. Records on important jobs bear this out.

THE CLEVELAND TRENCHER CO.

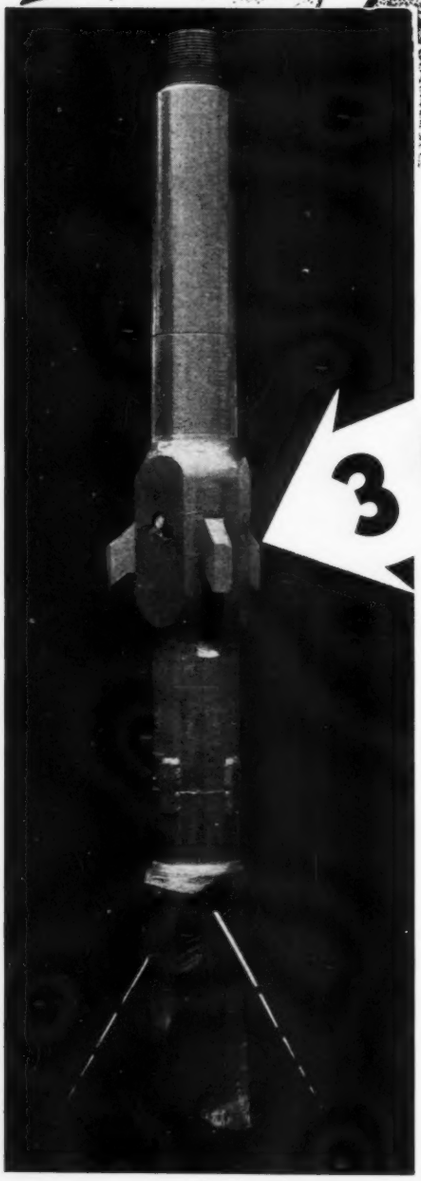
20100 St. Clair Avenue **CLEVELAND, OHIO**

One Important Cleveland idea that increases value. High-speed, low-cost transportation via special trailer. Load or unload in 10 to 15 minutes. Machine-savings made available even on scattered short lines, "hot-spots" reconditioning, etc.

CLEVELANDS

A 22,600 G. P. M. Marley forced draft tower in industrial service.
MARLEY leads the field with an installed water cooling capacity of more than four million G.P.M. And improvements for 1937 make Marley cooling towers still more outstanding in design and performance. For efficient, economical water cooling, see
THE MARLEY COMPANY, Kansas City, Missouri
MARLEY
WATER COOLING SYSTEMS

LESS LOAD PER CUTTER
MORE HOLE PER RUN!



3 CUTTERS

on the MacClatchie wall scraper give you, not only the many advantages of smooth, STABILIZED performance, but also more **full gauge** hole per run. Each cutter carries only one-third of the total load, which means less wear per cutter and more even distribution of torsional strains on the body and blades. Result . . . a smooth, even performance that is easy on the drilling string, that absolutely eliminates egg-shaped holes, and that actually gives more **full gauge** hole per run in all formations.

Now check these additional features!

TREMENDOUS BODY STRENGTH . . . by the use of alloy steels, correctly shaped and properly heat treated. Note how body is shaped to reinforce the blades.

POSITIVE CUTTER EXPANSION . . . that gives an unmistakable signal when the blades are expanded. No worry, no wasted round trips. You know it's working for you every minute it's in the hole.

DUO-ACTION CIRCULATION . . . that provides positive circulation at each cutter PLUS additional circulation right through the body to the pilot bit below. This is invaluable when working through bridges and other obstructions in the hole where circulation on the pilot bit is an absolute necessity.

No matter what your job, the MacClatchie will do the work quicker, smoother, and more reliably. Contact your nearest MacClatchie representative for complete information.

Mac CLATCHIE MANUFACTURING CO.

Compton, California **Houston, Texas**

Export: Geo. R. Woods, 17 Battery Place, New York City

Gas Burner Improved

ANNOUNCEMENT is made by the Natural Gas Equipment Company of Texas of an improvement in the design of the N.G.E.-Nelson Series 1000 Gas Burner used for firing oil field boilers. A newly designed damper operator combines the diaphragm mechanism with the gas valve in such a way that any increase in the gas pressure sufficient to open the gas valve also will open air louvres to the burners in the correct amount, affording controlled combustion. The gas valve is designed to produce a graduated flow in proportion to valve lift so that the

DAMPER OPERATOR

air flow through the burner and the gas flow may be adjusted with extreme accuracy. The valve is a single port valve with a number of V-shaped slots through which the gas is admitted to the burner header as the valve opens.

The extreme compactness of this device, which obtains automatic air-gas proportioning, eliminates the use of the clevises connecting links that ordinarily combine diaphragm mechanism with the gas valve; it has also made possible the elimination of all stuffing boxes, the manufacturers state.

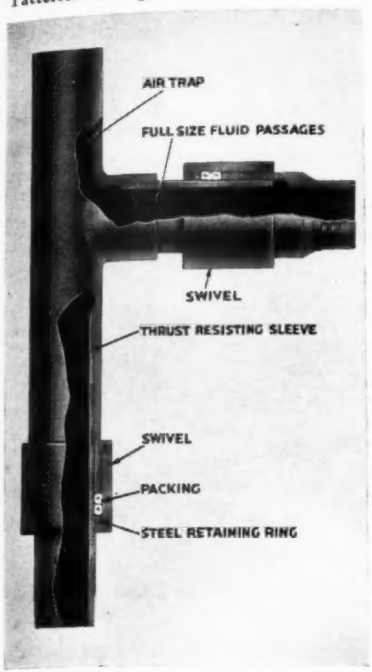
The admittance of air supply to the interior of the burner box also has been materially improved by placing three louvre doors on each side of the burner instead of in the ends of the box structure that previously projected from the side wall of the burner box.

Other features claimed by the manufacturer of this oil field boiler gas burner are: Installation time of 45 minutes, elimination of firebrick combustion chamber, masonry and brickwork; full portability, permitting quick installation or easy removal when boiler locations are changed; and extreme manifolding flexibility, suiting it to installation in any type, size or make of boiler without alteration.

A new bulletin, completely describing this improved burner, is available from the manufacturers, Natural Gas Equipment Company of Texas, 511 Sterling Building, Houston, Texas.

Safety Mud Gun

AN improved safety mud gun for spraying rotary mud and properly mixing it has been developed by Patterson-Ballagh Corporation. This



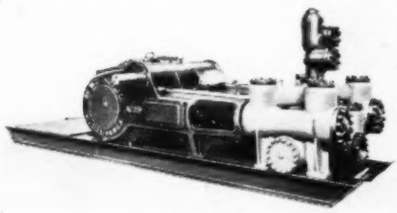
product has a double swivel and offers safety features that adapt it for use in the highest gas pressure areas, the manufacturers state. Double swivels turn on packing glands, permitting a positive joint that easily can be positioned by a single operator. The packing is easily taken up or replaced and is locked after being taken up. A long vertical inside sleeve takes the side thrust. An air trap eliminates sand-cutting. The area where wear is concentrated is entirely constructed of high-test tubular stock and the gun jet or nozzle is made of Patterson-Ballagh rubber similar to the kind used in the company's casing protectors.

A bulletin describing the Patterson-Ballagh Safety Mud Gun may be obtained by writing to the manufacturers at 1900 East 65th Street, Los Angeles, California.

Oilwell Power-Driven Slush Pumps

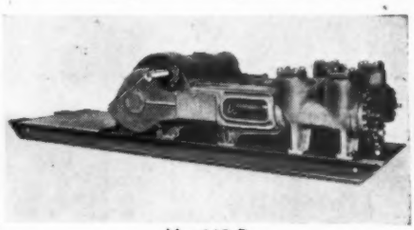
THE new No. 20-P (7¾ in. by 20 in.) power slush pump, manufactured by the Oil Well Supply Company, is especially designed and constructed for trouble-free service in rigs requiring both maximum circulation and high mud pressure, the manufacturers state. It is recommended by the makers for a maximum input of 415 hp. at 50 r.p.m. pump speed (270 r.p.m. pinion speed.)

The new "Oilwell" No. 612-P (6 in. by 12 in.) power pump is of the double-acting duplex piston type and



No. 20-P

is intended primarily for slush pump service on light rigs. It can be equipped with snap-ring pistons and modified valve service, however, for use in water supply or oil gathering systems.



No. 612-P

Its maximum input is 125 hp. at 60 r.p.m. pump speed (300 r.p.m. of pinion shaft.)

THE WEIGHT INDICATOR WITH LABORATORY ACCURACY AND OIL FIELD RUGGEDNESS

You CAN'T Compromise WITH ACCURACY

Your weight indicator is either accurate or NOT accurate . . . there is no compromise, and "half accuracy" is not enough! In the Martin-Decker "Clipper" you get the complete CUSTOM-MADE accuracy of a weight indicator to fit your particular need, for in the "Clipper" you have always at hand a choice of calibrated dial rings to meet every condition. Ten easily changed dials nested within the water-tight case allow DIRECT READINGS IN POUNDS OR POINTS for any line (whether 1", 1⅛" or 1¼" for drilling or ¾" or ⅞" for production work) and in any "string-up" from 4 to 10 lines, eliminating haphazard guesswork and estimations.

This is only one of the many features that make the new "Clipper" the most accurate weight indicator. For complete information, write for new literature.

THE WEIGHT INDICATOR
MARTIN DECKER CORP.
LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Bakersfield, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY Houston, Texas

And Consider These PLUS Values of Purchased Electric Power

- This is a year for expansion and aggressive methods; the substantial sums you can save by electric installations can be used to unprecedented advantage in your business.

- Lower fixed charges, such as taxes, interest, insurance, depreciation.
- Accurate records more easily kept — one bill each month covers everything.
- Fewer accidents.
- Less fire hazard.
- Lower maintenance cost.
- Lower labor cost.
- Less trouble, fewer repairs, smoother operation.
- Smaller warehouse stock of repair parts.
- Longer life for all equipment.
- Easy to start in any weather.
- Operation can be controlled automatically.
- Less shut-down time; highly dependable.
- Not affected by freezing in gas or water lines.
- Not affected by sour gas or gas shortage.
- Not affected by bad water or shortage of water.
- High salvage value—easily moved.
- Clean, efficient, modern.

An Engineer from your Power Company — not a salesman — would like to confer with you on these advantages.

PETROLEUM ELECTRIC POWER CLUB

Book Reviews

Flow Meter Engineering Handbook. Published by the Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company, Wayne and Roberts Avenues, Philadelphia, Pennsylvania. 164 pp. Bound in Spanish grain leather. Price, $2.00.

This handbook covers every phase of flow meter engineering principles, designs, applications, and installation, as well as all types of fluid measuring equipment using the orifice.

The Brown Flow Meter Engineering Handbook in time-saving, convenient form, gives complete information on the following subjects:

1. General Flow Meter Engineering.
2. Orifice Design.
3. Steam Flow Measurement.
4. Water Flow Measurement.
5. Liquid Flow Measurement.
6. Air and Gas Flow Measurement.

All theory is illustrated with charts, photographs, and sample problems.

* * *

Minerals Yearbook 1936. Published by the U. S. Bureau of Mines, Washington, D. C. 1136 pp. 154 illus. Complete index. Price, $2.00.

This volume reviews the mineral industry during the calendar year 1935, both in the United States and abroad. It contains official government statistical information on nearly 100 metals, minerals, and mineral products. Illustrations include charts showing world production and international flow of 33 mineral commodities. The book is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

* * *

Compilation of A.S.T.M. Standards on Petroleum Products. Published by American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pennsylvania. 372 pp. Heavy paper cover. Price, $2.00 per copy, special prices for orders of ten or more copies.

The current (1936) edition of the compilation of "A.S.T.M. Standards on Petroleum Products and Lubricants," sponsored each year by Committee D-2, gives in their latest approved form 56 methods of test, five specifications and two lists of definitions of terms relating to petroleum and to road materials.

The 1936 report of Committee D-2 discusses the research and standardization work, details the changes made in the standards, and also gives four proposed methods that have been approved for publication as information and for comment. They cover the determination of kinematic viscosity with the suspended level viscosimeter and by the modified Ostwald viscosimeter, converting kinematic viscosity to Saybolt, and a test method for neutralization number (potentiometer method).

The D-2 report also gives suggested uniform automotive engine lubrication recommendations and there is discussion of the development of color standards for the A.S.T.M. Union Colorimeter.

Standards are given in the publication pertaining to a large number of petroleum products, including kerosene oils, lubricating oils, petrolatum, refined petroleum oil, crude petroleum, gasoline, naphtha, etc., natural gasoline, grease, paraffin wax, bituminous materials, fuel oils, and emulsified asphalts.

Program for Houston Oil Show Under Way

IN ORDER to provide a thorough coverage of every branch of the petroleum industry at the Oil-World Exposition, which will be held in Houston, Texas, from October 11 to 16, inclusive, a definite and complete program was outlined at a meeting of the board of directors held on February 18. At this meeting a program committee was appointed consisting of R. L. Dudley, chairman; E. G. Lenzner, assistant chairman, and the following members: George A. Hill, Jr., president, Houston Oil Company; Chase Sutton, division manager, Pure Oil Company; and Frank Carothers, district manager, Norvell-Wilder Supply Company. Sub-Committees to take charge of specific activities also were named as follows:

Refinery Committee: W. H. Curtin, president, W. H. Curtin and Company, chairman; O. E. Berg, Babcock and Wilcox Tube Company; M. N. Dannenbaum, M. N. Dannenbaum Company; R. L. Mallory, Brown Instrument Company; W. J. Peddie, Maintenance Engineering Corporation; and George Reid, editor of Refiner magazine.

Under supervision of the refinery committee a technical instrument school will be organized, sponsored by Rice Institute, University of Texas, and A. & M. College. This technical school will be similar to the meter school of the University of Oklahoma and representatives of the leading manufacturers of meters and instruments will assist in presenting equipment and giving practical demonstrations. The refinery committee itself will be aided by engineers of the oil companies, refineries and gasoline plants.

Directional Drilling Committee: G. B. Corless, Humble Oil and Refining Company, chairman; Alexander Anderson, Alexander Anderson, Inc.; H. John Eastman, Eastman Oil Well Survey Company; R. S. Hyer, Sperry-Sun Well Surveying Company; A. B. Patterson, The Texas Company; M. L. Cashion, Gulf Production Company; and D. B. Collins, Shell Petroleum Corporation.

This committee will present a program dealing with new developments in directional drilling and surveying that will extend throughout the week of the Oil Show.

Drilling Committee: Joe Russell, Gulf Production Company, chairman. The extensive work of this committee is now being outlined with individual members being selected to handle specific phases of drilling technique. Programs covering all kinds of drilling operations will be presented throughout the week.

Production Committee: B. M. Nowery, United Gas Public Service Company, chairman. Production methods under various conditions will be treated by members of this committee, which will provide speakers on particular subjects during the technical sessions to be held during the show.

Associations and Conventions Committee: Chase Sutton, division manager, Pure Oil Company, chairman; Wm. V. Vietti, American Institute of Mining and Metallurgical Engineers; Carl Hickman, American Petroleum Institute, Gulf Coast Division; Phil F. Martyn, Houston Geological Society; W. B. Preston, American Society of Mechanical Engineers; A. T. McDannald, Drilling Contractors Meeting; C. E. Buchner, Independent Petroleum Association; James Anderson, Humble Oil and Refining Company; and George A. Hill, Jr., Houston Oil Company.

The meetings of the various societies will be of outstanding interest during the Exposition and under the management of the committee named are expected to provide valuable data for the entire oil industry.

Safety and First Aid Committee: J. J. Delahide, E. D. Bullard Company, chairman; Geo. J. Gruber, Mine Safety Appliances Company; R. B. Roaper, Humble Oil and Refining Company; Claude Liles, Magnolia Petroleum Company; Pete Keegan, Shell Petroleum Corporation; Tom Brown, Gulf Production Company; Jerry Lockwood, Empire Oil and Refining Company; Cecil Hightower, United Gas Public Service Company; and C. A. Miller, The Texas Company.

In addition to all matters pertaining to safety in field and plant, this committee will have charge of the first aid contests that will be a feature of the Oil Show.

New Patents and Inventions Committee: Lester B. Clark, patent attorney, chairman. Exhibiting space will be provided inventors to show new patents and one evening will be assigned for talks and demonstrations of new inventions.

Attendance Committee: George A. Hill, Jr., Houston Oil Company, and W. L. Childs, Reed Roller Bit Company, chairmen; T. J. Donoghue, The Texas Company; A. M. McCorkle, Stanolind Oil and Gas Company; A. T. McDannald, Smith & McDannald; C. B. Moore, Frick-Reid Supply Corporation; B. M. Nowery, United Gas Public Service Company; George O'Leary, Houston Oil Field Material Company; C. R. Patterson, National Supply Company; M. W. Phelps, Oil Well Supply Company; Joe Russell, Gulf Production Company; T. E. Swigart, Shell Petroleum Corporation; and F. H. Thrailkill, Continental Supply Company.

A sub-committee to take charge of foreign attendance will be selected later.

Entertainment Committee: Frank Carothers, Norvell-Wilder Supply Company, chairman; Robert J. Miller, Robert J. Miller Company; George O'Leary, Houston Oil Field Material Company; and S. T. Childress, Rio Bravo Oil Company.

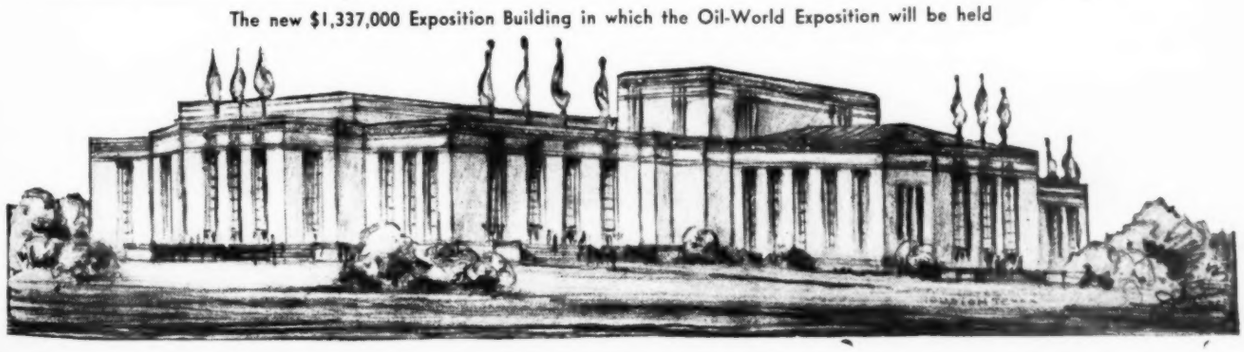
In addition to the entertainment programs being prepared by this committee, the Wildcat Committee will give a banquet with special features in addition to the show put on by its own members.

Oil Equipment Export Committee: Under the chairmanship of Thomas E. Ward, president, Oilfield Equipment Company, Inc., and the following committee, an extensive program is planned to consist of several meetings that will be of value to the foreign visitors and to the manufacturing companies serving foreign fields:

P. A. Bogdanoff, president, Amtorg Trading Corporation, New York; J. W. Casterton, purchasing agent, Standard Oil Company of New Jersey, New York; J. A. de Lanoy, director of purchases, Asiatic Petroleum Corporation, New York; P. W. Fenton, purchasing agent, Tide Water Oil Company, New York; W. G. Foster, president, Anglo-American Purchasing Company, New York; W. J. Malloy, American representative, Oil Well Engineering Company, New York; H. B. Malone, director of purchases, Consolidated Oil Corporation, New York; E. B. Middlekauf, purchasing agent, The Texas Company, New York; J. S. Parks, purchasing agent, Atlantic Refining Company, Philadelphia, Pennsylvania; F. J. Petura, purchasing agent, Henry L. Doherty and Company, New York; H. Slater, purchasing agent, Venezuela Gulf Oil Corporation, New York; J. R. Taylor, purchasing agent, Socony Vacuum Corporation, New York; O. P. Wegner, engineer, Argentine Government Oil Fields, New York; J. A. Whitely, purchasing agent, Pan American Petroleum and Transport Company, New York; George W. Young, purchasing agent, Standard Vacuum Oil Company, New York; Clyde Ellwood, Fluid Packed Pump Company, formerly export manager, Axelson Machine Company; Jack Mellon, export manager, Byron Jackson Company; W. F. Huff, Bettis Rubber Company, formerly export manager National Supply Company; Robert J. Eiche, export manager, Los Angeles, California; and Bert R. Emerick, sales manager, P. & D. Specialty Company, formerly general superintendent, Burmah Oil Company.

E. G. Lenzner, general manager of the Oil-World Exposition, Inc., will serve as assistant chairman on all committees in order to coordinate the work of the various projects and assist in the completion of all plans.

The new $1,337,000 Exposition Building in which the Oil-World Exposition will be held



Combating Freezing of High-Pressure Gas Lines

How a troublesome condition was overcome successfully and economically by simple methods

By
W. J. GRISSETT*

WHEN the Big Lake Oil Company began producing its deep (8500-ft.) wells in Reagan County, Texas, by gas-lift, it was confronted by trouble resulting from the freezing of high-pressure gas lines in cool weather. Various methods were suggested and many tried. One of the first remedies tried, and also one of the more successful, was the use of gas heaters. They were of several different types; but at best, all were efficient for only 1000 ft. to 1500 ft. of pipe in cold weather.

Another method was the placing of alcohol in the lines, introducing it through lubricators and at specified intervals. Because of the expense involved, only a limited quantity of alcohol was used; so there always was a question whether the alcohol was of any great benefit. One place where alcohol lubricated into the line unquestionably was satisfactory was where the gas was being "pinched," or the pressure lowered.

Each succeeding winter the quantity of salt water produced by the wells supplying the high-pressure gas increased and the gas at the well became warmer—at least those wells making a higher percentage of water produced warmer fluids, and the gas lines from these wells were affected by "freeze-ups" more than the lines from wells making cooler fluids.

This past winter the troublesome condition began earlier and was more severe than formerly. Often freeze-ups occurred when the temperature was approximately 60 deg. fahr., especially if the humidity were 50 or above.

About the middle of November the writer began experimenting with oil, running a small quantity from the high-pressure separator into the gas lines. During the subsequent seven weeks only two freeze-ups occurred, and those were in the gas lines from the separator and while the process was still in an experimental stage. Even then the ice in the line was so slushy that it was easily removed by "blowing" the line.

An estimate of the volume of oil used daily can only be approximated (it was probably 5 to 12 bbl. as determined by measuring in the separators), because the daily total gauge of the gas-lift well increased when interference with the gas supply was lessened, and the total daily gauge also increased on the supply wells as a result of the absence of periodic excessive back pressures caused by freezing of the gas lines. The supply well using five bbl. of oil in its gas line daily produces 42-gravity oil (cut) and has not had a freeze-up in its gas system since oil was first used. Formerly, one to three freeze-ups daily frequently would occur despite the use of alcohol. The writer believes, however, that had it been practical to use alcohol in quantities equal to that of the oil used, the results with the alcohol also would have been satisfactory.

From experiments with the use of oil the writer has found that:

(1) It is best to take oil from near the top of the liquid level in the separator;

(2) The oil line from sight feed to gas line should be of ½-in. pipe or larger;

(3) The oil line gives best service if it has very short vertical runs, no horizontal sections, and long bends are used rather than ells;

(4) Where heavy or cut oil is used a blow-off valve is necessary to keep the line open. A line valve on the upstream and one on the downstream side of the blow-off valve is essential;

(5) Heavier oils are more efficient for this purpose than lighter oils and distillate;

(6) Oils placed in the lines at the source prevented freezing of the line its entire length, 3500 to 6500 feet.

*Big Lake Oil Company, Texon, Texas.

Emco Service Regulator Testing Machine

WHEN repairs to service regulators of either a major or minor nature are required, many companies prefer to remove the regulator from service for a general reconditioning in the service shop. To provide a simple and convenient method for testing regulators of this type, both as received and after repairs have been made, the Pittsburgh Equitable Meter Company has developed the Emco

Testing Machine. It has numerous features that permit quick effective testing and adjusting following a recommended test procedure.

This unit is made to accommodate regulator sizes from ¾ in. to 1½ in., inclusive, merely by changing adaptors and guides. Either air or gas can be used for making the tests. All the necessary gauges for indicating inlet and outlet pressures are included. The mechanical construction is such that the regulator can be quickly placed in position, clamped securely, tested, and quickly removed. A simple test method may be employed using calibrated orifices to obtain two test flow rates. If more extensive tests are desired, an Emco Indicating Flow Meter can be installed in the outlet line to read all flow rates.

The test unit is compact yet exceptionally rugged to withstand heavy duty service. It can be readily installed by bolting to a convenient bench and connecting air or gas line to the inlet connection.

I. FRANK BROWN

I. Frank Brown Is Handling Foreign Sales for Baash-Ross

The appointment of I. Frank Brown as foreign sales representative of Baash-Ross Tool Company, Los Angeles and Houston, is announced by H. C. Ross, vice-president and general sales manager of the company. The appointment became effective March 1, 1937. Brown maintains offices at No. 30 Rockefeller Plaza, New York City, and has acted in the capacity of sales representative in foreign oil fields for many years.

how will it help in YOUR WELL?

(Patented)

Write our nearest office or distributor for full details.

How will the Sievers Reamer help in *your well* is a perfectly logical question and here are 6 perfectly logical answers—

1. Because the cutters contact from 30 to 45% of the circumference of the hole, the drilling bit is centered and effectively stabilized. This results in smooth, concentric rotation of the bit, permitting fast, straight hole drilling.

2. Because of the angle at which the cutters are set in the reamer body, the formation is sheared with a natural downward slicing action, permitting a *full gauge* hole to be reamed, with less effort, with less weight on the drilling string and in less time than with conventional types of reamers.

3. Because of the downward shearing action of the cutters, the natural wear and thrust on cutter pins, reamer body and moving parts is held to an absolute minimum. This means less shut-down time for repairs and parts replacement with lower footage costs.

4. Because, when coring, the stabilizing action of the reamer assists in maintaining rotation of the core barrel on its true axis, resulting in higher core recovery—particularly in soft or broken strata.

5. Because of the patented locking device, the entire reamer assembly is held securely in place, eliminating costly breakage or loss of parts. Highest factor of safety to well and equipment is thus asured.

6. Because of their large contacting area, the cutters, when replaced with hardened steel, knurled rollers, transforms the reamer into an excellent tool for rolling out battered or collapsed casing.

Everything that you expect a reamer to do . . . and then some.

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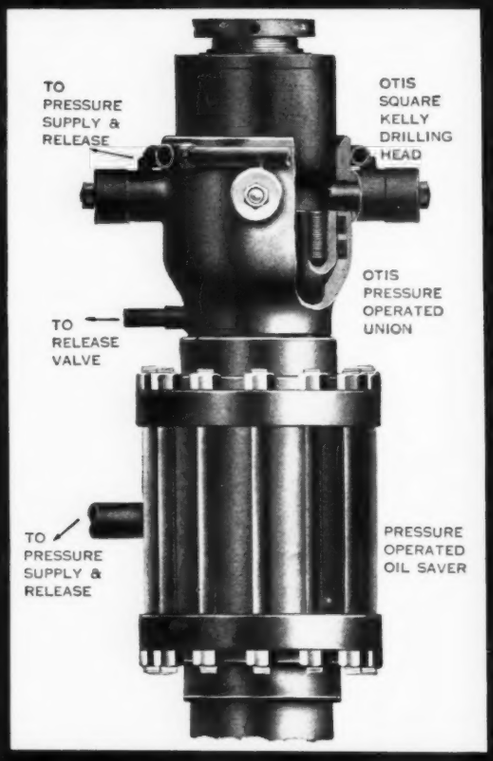
NO MORE TRIPS TO THE CELLAR *—while drilling in*


TO PRESSURE SUPPLY & RELEASE
OTIS SQUARE KELLY DRILLING HEAD
OTIS PRESSURE OPERATED UNION
TO RELEASE VALVE
TO PRESSURE SUPPLY & RELEASE
PRESSURE OPERATED OIL SAVER

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With the addition of the Otis pressure operated union to the Otis square kelly drilling head assembly it is no longer necessary to go beneath the derrick floor during the course of drilling-in operations.

This means to the men on the job not only vastly increased safety, but cleaner, more convenient working conditions, to say nothing of the time saved for the operator who pays the bills. Full details on this and other Otis products and services are yours for the asking.

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PRESSURE CONTROL — OTIS — SERVICE – EQUIPMENT

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Houston, Shreveport, Oklahoma City, Ada, Hobbs.

Anchor Packing Opens Tulsa Office

B. M. HOWELL

The Anchor Packing Company, of Philadelphia, Pennsylvania, has opened an office and warehouse in Tulsa, Oklahoma, its first branch in the Mid-Continent. The office is in the Thompson Building and B. M. Howell is in charge. Howell, for 14 years, was with the New York Rubber Packing Company as sales manager of the Mid-Continent division.

The Anchor Packing Company manufactures packings for all purposes and a complete stock is maintained at Tulsa. Brake linings and friction blocks also are handled.

E. W. Brockman to Tulsa for Rector

E. W. Brockman has been placed in charge of the Tulsa office of the Rector Well Equipment Company of Fort Worth. He will cover the Oklahoma and Kansas fields. L. L. Rector is making a trip to the Rocky Mountain fields, and among other points will visit Denver and Casper.

Death Takes R. W. Gotshall

Friends and associates throughout the United States and abroad were grieved to learn of the recent death of Robert W. Gotshall, general sales representative for Caterpillar Tractor Company, and pioneer in the development of the track-type tractor. Death came to Gotshall after an illness of six months, in St. Francis Hospital, Peoria, Illinois. Funeral services were held at Peoria after which the body was taken to Lakeside Cemetery, Minneapolis, Minnesota, for burial.

Gotshall was born in Minneapolis on December 2, 1882. He was graduated from the University of Michigan, School of Engineering, in 1906.

Immediately entering the field that was to become his life work, Gotshall joined the engineering forces of the Union Iron Works at Minneapolis soon after his graduation. Not long afterwards, The Holt Manufacturing Company of Stockton, California, decided to establish a manufacturing branch at Peoria, Illinois. M. M. Baker, who was in charge of the eastern development of California concern, called Gotshall to Peoria, and as a result the first "Caterpillar" track-type tractor to be built east of the Rocky Mountains was produced under Gotshall's supervision. He became exclusive assistant to Baker.

He remained with the Holt company until a year after its merger with the C. L. Best Tractor Company as Caterpillar Tractor Company. In 1925 he joined the Monarch Tractor Company at Springfield, Illinois, and when this firm became a part of the Allis-Chalmers Manufacturing Company, he became an active leader in the promotion of that firm's road machinery business.

Returning to Caterpillar Tractor Company two years ago, Gotshall took over the manifold duties of general sales representative and remained at that post until his death.

Bureau of Mines Films Shown Vast Audience

A total of 7,252,000 Americans learned something of how minerals are produced and utilized through attendance at the showing of the educational motion picture films of the U. S. Bureau of Mines, Department of the Interior, during the year 1936. The films, covering 57 different subjects, were exhibited on 84,783 occasions, the attendance figures exceeding those of any previous year. Approximately 500 reels were added to the Bureau of Mines motion-picture library during the year, making over 3000 reels available for distribution. The cost of producing the films is borne by cooperating industrial concerns. The films are used by educational institutions and engineering societies throughout the country. Some of the films have actually been made a part of prescribed courses in certain colleges.

The films depict mining and related manufacturing processes; they show where minerals are found and how they are extracted from the earth, manufactured or refined into useful everyday products, utilized, and conserved. The prevention of accidents and the protection of human life have been given special attention, and several pictures deal specifically with this important subject.

A number of films show operations in the extensive petroleum industry and visualize just how oil is produced, refined, distributed, and utilized in the United States and in numerous foreign countries.

Joins Martin-Decker Sales Force

TOM MURPHY

Martin-Decker Corporation announce the appointment of Tom Murphy as Los Angeles Basin and Coast territory salesman. After attending U. C. L. A. Murphy worked several years for one of the major oil companies and recently spent considerable time in the Martin-Decker plant at Long Beach, familiarizing himself with the design and assembly of the "Quintuplex", the Clipper and other Martin-Decker instruments.

Recent Progress in Alloy Steels

H. J. French recently addressed several Ohio chapters of the American Society for Metals at their meetings in Columbus, Dayton, and Cincinnati. In these talks, French reviewed the more interesting phases of the year's progress in the manufacture, selection, and utilization of alloy steels. Included among the topics discussed at the meeting were:

The widening of the field of welded construction as the result of rapid advancement in the art of joining alloy steels that has been reflected in increased use of these steels;

The development of high strength, semi-corrosion-resistant steels of comparatively low cost and moderately improved properties;

The improvement of the fatigue-tensile ratio of normalized steels by the use of nickel as a ferrite strengthener; this is important in selecting appropriate compositions for railway axles and heavy forgings;

The importance of retained austenite in influencing the impact strength of gear materials.

French, in charge of alloy steel and iron development for The International Nickel Company, Inc., used lantern slides to illustrate his talks.

The Columbus Chapter held its meeting March 9th; the Dayton meeting was at the Engineers' Club March 10th, and was preceded by a dinner; the Cincinnati meeting was March 11th at the Hotel Alms, preceded by a dinner and coffee speaker.

NOTICE

Declaratory judgment in favor of Patterson-Ballagh Corporation has been rendered in the U. S. District Court, southern district of California, in a patent suit involving the expander tool used in applying rubber protectors. William I. Bettis, plaintiff, sought declaratory judgment to invalidate the patent. Federal Judge Leon Yankwich in his decision stated: "This cause having been heard . . . and evidence oral and documentary having been introduced, . . . the Court having considered the evidence and the law . . . , now find in favor of the Defendant . . . and that a Declaratory Judgment in favor of the Defendant be entered declaring and decreeing the letters patent No. 1,965,876 are good and valid in law and that the same were lawfully issued on July 10, 1934, and that the invention covered thereby was not abandoned by the inventor thereof and was not in public use more than two years prior to the time of the filing of the application for said patent . . . "

Patterson-Ballagh Corporation

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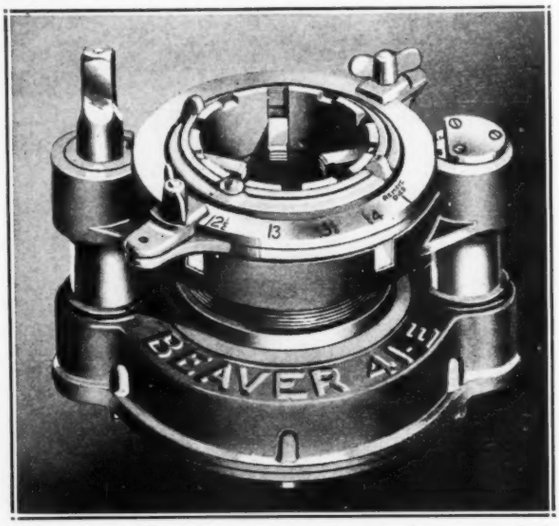
BEAVER NO. 41-E 2½ to 4"



Beaver Geared Threaders are popular because they cut standard, under or over size, to meet variations in fittings, without affecting the length of thread—thus assuring tight joints. In No. 41-E, 2½ to 4-inch and No. 61-E, 2½ to 6-inch, the gears are fully enclosed and packed in graphite grease. Sand, chips or other foreign matter cannot get in the gear case to damage the gear and pinion. Thus, the principal cause of trouble in geared tools is eliminated. A patented Beaver advantage. Price No. 41-E, complete, $50.00—through your supply house.

BEAVER PIPE TOOLS

337 Petrol Avenue Warren, Ohio

Simplifies THE BIG JOBS

Put a Buckeye Ditcher on any job, and you can be sure that the ditch will be completed at lowest cost and right on schedule.

For the BIG jobs, you will need the Buckeye Model 48 that digs trench from 22 inches to 40 inches in width and up to 8½ feet deep. May we send you complete operating data?

Use Model 48 by Buckeye

FOR THE BIG JOBS—

BID THE Buckeye WAY ask for our operation data before you bid

THE BUCKEYE TRACTION DITCHER CO., FINDLAY, O.

Trade Personals

R. H. CHERRY, sales manager, Wickwire Spencer Steel Corporation, New York City, has returned from a month's trip to Florida, Mid-Continent, and Gulf Coast fields.

●

HARVEY L. MILLER, assistant manager of sales of tubular products, Jones & Laughlin Steel Corporation, Pittsburgh, Pennsylvania, now has his headquarters in the Magnolia Building, Dallas, Texas. A. P. HOLLOWAY, district manager at Dallas, now is at Pittsburgh in the tube sales department.

●

H. P. MEE, vice-president of Caterpillar Tractor Company, Peoria, Illinois, announces the appointment of E. R. (ED) GALVIN as general sales manager of the company, effective March 1. Galvin has been assistant sales manager. Mee, who as vice-president, not only has had immediate supervision of the sales department, but also direction of advertising and service activities, relinquishes direct supervision of the sales department for the broader duties of directing all sales, service, and advertising activities, and to assist more fully in general company administration matters.

●

L. A. HINES has been assigned to cover the Texas oil fields as a special traveling representative for the Macwhyte Company, Kenosha, Wisconsin, makers of wire lines. Heretofore, Hines has been in charge of the Macwhyte Company's office and warehouse stock in Fort Worth, Texas. Replacing Hines in Fort Worth, is GOODWIN JOHNSTON from the Macwhyte general offices at Kenosha, Wisconsin.

●

MANLY B. BROWN has been appointed assistant manager of sales, pipe division of Republic Steel Corporation, and will devote his efforts to oil country tubular sales, according to N. J. CLARKE, vice-president in charge of sales. Brown has been associated as eastern representative of Wilson & Bennett Manufacturing Company, and prior to his connection with that concern was Chicago representative of the Ohio Corrugating Company, and for eight years was district sales manager in Chicago for the Wheeling Steel Corporation. Brown will make his headquarters in the Republic Building, Cleveland, Ohio.

●

A. W. BRANSCUM, who has been engaged in field sales for W. C. Norris, Manufacturer, Inc., Tulsa, Oklahoma, for a number of years in Oklahoma, has been transferred to Big Spring, Texas, as manager of the company's branch at that point. Branscum succeeds GLENN HOLTZMAN, resigned.

●

FRANK CHAMPION, general sales manager of the Oil Tool Division of Byron Jackson Company, Los Angeles, California, is now in New York City following the Mid-Continent sales meeting of his organization held at Fort Worth late in February. Returning through the Mid-Continent, Champion expects to be back in California about the middle of March.

●

HENRY P. HAHN has become a member of the engineering staff of the Crosby Steam Gage and Valve Company, New York. Hahn for many years was attached to the engineering

staff of the Crane Co., and for the past five years has been chief engineer of the oil and refining department of the Société Anonyme des Établissements Jules Cocard, Paris, France.

●

BRUCE B. WALLACE has joined the staff of the Los Angeles office of the Foxboro Company, Foxboro, Massachusetts, makers of industrial precision instruments. Wallace will work out of Los Angeles as a sales engineer.

●

H. F. HENRIQUES and J. J. LINCOLN, JR., have been appointed assistant general sales managers of Air Reduction Sales Company, New York City, with headquarters in Cleveland and Pittsburgh, respectively. Henriques has been a member of the sales department of Air Reduction since March, 1929, and was manager of the Cleveland district from January, 1934, until he assumed his new position. Lincoln joined Air Reduction in 1924 and was appointed manager of the Pittsburgh district in May, 1934. J. M. DRISCOLL has been appointed acting manager at Cleveland, and S. D. EDSALL has been appointed acting district manager of the Pittsburgh district. A. W. BROWN has been appointed assistant railroad sales manager with headquarters in New York. J. F. PRYOR, formerly assistant to the general sales manager, has been appointed vice-president of the Magnolia Airco Gas Products Company. This company is a Texas corporation handling all of Air Reduction's activities within that state. Pryor will make his headquarters in Houston.

●

N. B. GILLILAND has been appointed to the sales engineering staff of the Detroit office of the Lincoln Electric Company, Cleveland, Ohio. Gilliland has had three and one-half years of university training and one year's experience as assistant instructor of welding at Ohio State University.

●

PHIL S. STOVER, who has been with the Murray Tool and Supply Company for the last three years and who is well known in supply circles, has joined the staff of the Wilson Supply Company of Houston, Texas. His headquarters will be at Tulsa, Oklahoma. M. L. WILLIAMSON, who has been at Tulsa, is in charge of the new office of the company that has just been opened in the Magnolia Building, Dallas, Texas.

●

W. G. TAYLOR, of the industrial engineering department, General Electric Company, Schenectady, New York, recently spent ten days in Tulsa and Oklahoma City on business.

●

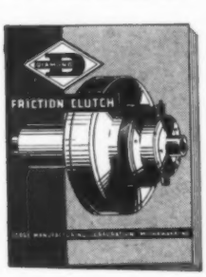
HOWARD B. HALL has been appointed regional director in charge of the Cleveland, Cincinnati, and Pittsburgh territories by Foster Wheeler Corporation, New York City. Hall assumed his duties as of March 1st, and will make his headquarters in the Cleveland office of the corporation at 526 Superior Avenue. For the last eight years he has been director of the Industrial Division of Murray and Flood, consulting engineers.

United Supply Opens New Branches

The United Supply and Manufacturing Company, Tulsa, announce the opening of several new branches. One at Chase, Kansas, to serve the Western Kansas fields. E. R. Will formerly of Hutchinson, Kansas, branch is in charge. C. M. Holland has been transferred from the Eunice, New Mexico, branch to take charge of office and store at Houston to serve Gulf Coast fields.

CAN *Absorb* THE SHOCKS OF CONTINUOUS OPERATION

In the oil fields—there are many times when equipment is subjected to terrific shocks . . . when power pressures test their capacities, often a fatal spot for clutches less rugged than Dodge Diamond "D" . . . Dodge Clutches are designed for normal or severe conditions . . . They are compact . . . rated to allow for 100% overload . . . have large friction areas . . . are completely enclosed insuring safety to workmen and full protection against dust and dirt.



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● *See the Dodge 20-page Section in the Oil Field Composite Catalog.* ●

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THERE IS ADDED VALUE IN THE NAME DODGE

Miller Sand Pumps

are inexpensive

Sediment in the Bottom of your well

is expensive

The powerful suction action in the MILLER enables you to quickly clean out the sand and mud in your wells.

MILLERS are now made in two weights of tubes—5/32" wall thickness in Regular and 1/4" wall thickness when Heavy sand pumps are needed.

The MILLER SAND PUMP *is the standard clean-out tool used by oil companies throughout the world!*

SAND BOTTOM

Used when tools are run and when well is shot to quickly remove loose material.

STAR BOTTOM

Used for cutting the sand loose.

BAILER BOTTOM

With the Bailer Bottom installed the Miller is changed to a Bailer, giving you a combination of either a Bailer or Sand Pump in one tool.

MILLER SAND PUMPS ARE SOLD BY SUPPLY COMPANIES EVERYWHERE

Write for Descriptive Folder and Price List

CHISEL BOTTOM
(In Pump)

Will often save the expense of running tools, as its chisel shape breaks up tightly-packed sands.

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Additions to International Supply Company Staff

International Supply Company announces two important additions to their ever-expanding organization. Roy

ROY A. JOHNSON

A. Johnson has been appointed manager of their recently organized machinery department, with headquarters in Tulsa, Oklahoma, and A. B.

A. B. HARRISON

Harrison becomes division manager for the Gulf Coast area with headquarters at Houston, Texas.

Johnson has a record of more than 20 years experience in the oil well supply business, having started with R. A. "Berry" Griffith in the Continental Supply Company organization back in 1916, where he was active for nine years. In 1925 he joined International Supply Company and in 1927 became associated with Oil Well Supply Company in charge of Franklin engines in Oklahoma and Kansas. In 1930 he went with Weber Engine Company in Kansas, later taking over that territory for Atlas Supply Company and Weber when they became distributors for the Weber engines there. In March, 1936, Johnson was transferred to Tulsa in charge of machinery sales for Atlas Supply Company until he joined International Supply Company.

Harrison began his career packing Mica axle grease for the Standard Oil Company at Whiting, Indiana, advancing through various refinery departments until 1918 when he joined the Sinclair Refining Company at East Chicago where he was engaged in the development of the Isom Process type of cracking unit. He later served as assistant superintendent of the Sinclair plant at Marcus Hook, Pennsylvania, until 1925. Stricken with the urge to enter sales work, Harrison joined the Hills-McCanna Company's force promoting the sale of aluminum bronze for cracking units and other oil industry uses. In 1928 he joined Chapman Valve Company at Philadelphia, from where he was transferred to Houston late in 1929. In 1934 he joined the Coastal Supply Company.

STRAIGHT TALK.... *about* CROOKED HOLES

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3118 Blodgett Avenue, Houston, Texas
549 East Bixby Road (3800 Block—Atlantic Ave.) Long Beach, Calif.

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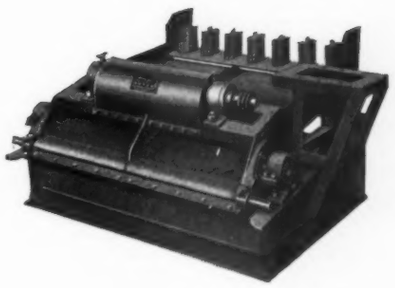

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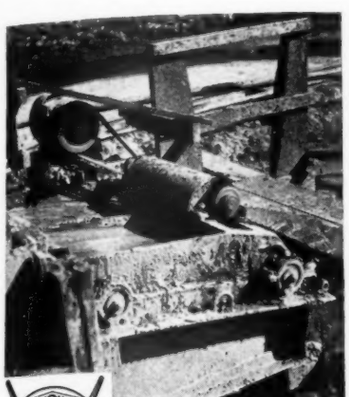
★ Ask your Supply House, see Page 1704 of the Composite Catalog, or write for detailed information.



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and Flow In or Out
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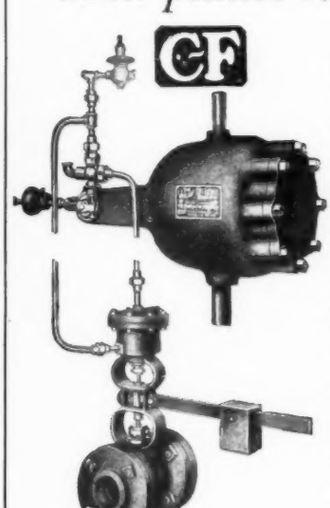

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Hough announces the new KAMONEX Ball and Seat. Made from a special alloy containing nickel and copper, KAMONEX will not corrode under the most severe sulphur-water conditions.

There's a specialized Hough Ball and Seat to meet every need. Each is heat-treated to correct hardness, vacuum-tested, and guaranteed tight.

Oil-field distributors carry Hough products in stock. The Charles N. Hough Mfg. Company, Franklin, Pa.

HOUGH *Specialized*
BALLS AND SEATS

Latex Construction Company Formed

L. H. Favrot and George A. Peterkin have formed the Latex Construction Company, Houston, Texas, to engage in pipe line construction and general contracting. The office of the new company is in the Second National Bank Building.

Prior to forming the Latex Favrot was president of the Apex Construction Company and vice-president of Williams Brothers Corporation. Peterkin was vice-president of both the Apex Construction Company and Williams Brothers Corporation.

Magnolia Changes

The Magnolia Petroleum Company and the Magnolia Pipe Line Company recently have made a number of changes in their operating personnel. J. L. Latimer, who has been general superintendent for the Magnolia Pipe Line Company in the Texas-Louisiana-Arkansas district, has been promoted to assistant manager to succeed W. A. Sniffen, recently placed on the retired list.

J. L. LATIMER

L. H. TRUE

L. H. True, superintendent of the Southwest Texas district for the pipe line, takes over Latimer's former post. His headquarters have been moved from Luling to Dallas. J. E. McGeath, who has been chief gauger for East Texas, Louisiana, and Arkansas, is the new Southwest Texas district superintendent, and has his headquarters at Alice.

E. D. Smith, general superintendent of Oklahoma for the Magnolia Petroleum Company, has been transferred from Oklahoma City to Dallas as assistant in the production department.

E. N. Wilson, who has been superintendent of production in the Longview, Texas, district for the last six years, becomes superintendent of Oklahoma.

E. D. SMITH

E. N. WILSON

Harvey Lee, field superintendent in the Cushing, Oklahoma, district, is the new superintendent at Longview; and Roy Wilson takes over Lee's old post at Cushing.

Magnolia also announces the creation of several new districts. A new production district has been formed in Western Kansas, with M. V. C. Bradley, Chase, field superintendent. In the natural gas and gasoline division of the company a new district has been created at Kermit, West Texas, with C. L. Simmons superintendent; and the Stonewall district has been formed in Oklahoma with Hugh B. Ervin as superintendent.

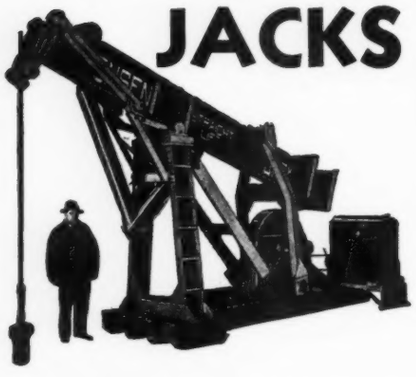
Appointed Distributor for Tube-Turns

The Vinson Supply Company, Hunt Building, Tulsa, Oklahoma, has been appointed a distributor for Tube-Turns, Inc. This company will carry a large stock of Tube-Turns, the entire line of Tube-Turn welding fittings and forged steel flanges.

JENSEN

Straight-Lift

JACKS



A million dollars couldn't hire the men who have co-operated with us for 19 years in designing and perfecting JENSEN Pumping Equipment. They include many of the most successful producers in the United States.

If you want economy and dependability in a straight-lift pumping unit—in other words, if you want to PUMP FOR PROFIT—we cordially invite you to investigate JENSEN JACKS.

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B.F.ORR General Mgr.

L. W. Stahl Joins Emsco Staff

L. W. "LES" STAHL

L. W. "Les" Stahl has joined the staff of the Emsco Derrick and Equipment Company, where he is heading a new department for the development of rotary drilling equipment. For the present he is at the home office of the company at Los Angeles, California.

Stahl, a member of the 1913 class in mechanical engineering at the University of California, began his oil field career with the National Supply Company. In 1936 he entered the engineering department of the Wilson-Snyder Manufacturing Company at their Braddock, Pennsylvania, plant, for the purpose of developing their line of slush pumps. At the time of the acquisition of the latter company by the Oil Well Supply Company and the subsequent merger of these into a subsidiary of the United States Steel Corporation, Stahl operated as a field engineer, residing at Houston, Texas. Upon the revival of drilling operations in California he was transferred there as California district engineer for Oil Well, which position he held until his affiliation with Emsco Derrick and Equipment Company.

Permian Basin Chapter A.P.I. Organized

Recently 38 oil men of West Texas and Southeastern New Mexico met in the Scharbauer Hotel, Midland, Texas, for the purpose of considering the organization of a local chapter of the American Petroleum Institute's Division of Production. The meeting was called to order by Harvey H. Hardison, who had been authorized to act as temporary chairman. T. A. Pollard acted as temporary secretary. It was the consensus of those present that a local chapter should be organized, to be known as the Permian Basin Chapter.

The following officers and advisory committee were elected: K. L. Sappington, chairman, Shell Petroleum Corporation, Midland, Texas; G. A. Poole, first vice-chairman, Gulf Oil Corporation, Odessa, Texas; H. L. Johnston, second vice-chairman, Continental Oil Company, Hobbs, New Mexico; Ben LeFever, third vice-chairman, American Maracaibo Oil Company, Big Spring, Texas; L. F. Shiplet, fourth vice-chairman, The Texas Company, Wink, Texas. Secretary-treasurer to be appointed by chairman.

Advisory committee: One year terms—Earl Griffin, Phillips Petroleum Company, Midland; F. E. Hatfield, Gulf Oil Corporation, Odessa; J. W. Jordan, Sinclair Prairie Oil Company, Midland; T. E. Keefer, Stanolind Oil and Gas Company, Wink; L. A. Neal, Landreth Production Company, Odessa; T. B. Sudderth, ME-Tex Supply Company, Hobbs. Two year terms—Glenn Bish, The Ohio Oil Company, Hobbs; W. E. Cunningham, Oil Well Drilling Company, Hobbs; W. T. Doherty, Humble Oil and Refining Company, Midland; Harvey H. Hardison, Standard Oil Company of Texas, Midland; J. K. Hufendick, The Texas Company, Wink; H. B. Hurley, Continental Oil Company, Big Spring.

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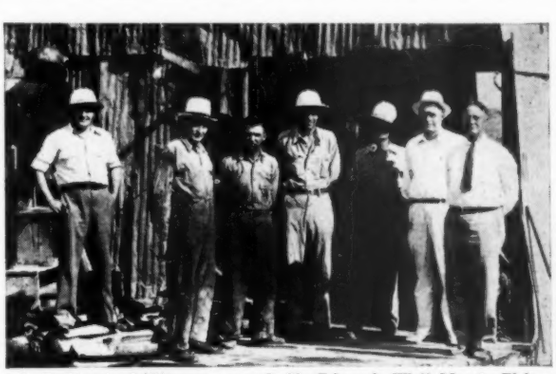

J. E. Bury's drilling crew at J. H. Edwards Well No. 1, Fisher County, Texas—R. J. Holdrige, R. Bowman, J. L. Blanton, D. F. Park, G. A. Bury, Y. A. McNeill and J. E. Bury, Contractor.

DOWN GO DRILLING COSTS!

Using a Model 140-DRB Young Diesel Drilling Engine, J. E. Bury of Hamlin, Texas, cut his fuel oil costs to $1.80 per day. The total cost of operating the Diesel Drilling Engine and Light Plant which included fuel oil, motor oil, pressure grease and gasoline for light plant, etc., was $3.08 per day. This record was made at a depth of 2,750 feet in a 10" hole, using 1" wire line, 5½ by 34' stem, jars, swivel socket and a 1,200 lb. 10" bit.

Young Engines are noted for their exceptional fuel economy, ease of operation, portability and effective power at all speeds. For complete information, write for Bulletin, 20-P, also see 1937 Composite Catalog. Young Engine Corporation, Canton, Ohio, or A. E. Avers, 230 E. 14th St., Tulsa, Okla.

YOUNG DRILLING ENGINES
GAS . . . GASOLINE . . . DIESEL

Interesting Program Scheduled for Southwestern District Meeting A.P.I. Expected To Draw Large Attendance

PLANS for the spring meeting of the Southwestern District of the American Petroleum Institute, Division of Production, are maturing rapidly, under the chairmanship of A. G. Levy of The Texas Company.

On Thursday, April 1, 1937, Wallace E. Pratt, vice-president of Humble Oil and Refining Company, will address the meeting on "Trends and Potentialities of Oil Development in Southwestern United States." W. R. Boyd, Jr., executive vice-president of the American Petroleum Institute in New York, and George A. Hill, Jr., vice-president in charge of the Production Division, also will address the meeting on subjects to be announced later. M. J. Norrell, vice-president of the Magnolia Petroleum Company, will deliver the address of welcome. A new viewpoint on the taxation problem also will be presented by Jake Hamon of Cox & Hamon, who will speak on "Taxation —An Over-riding Royalty."

An interesting technical program is in the course of preparation. The following papers will be presented:

"Foundations and Substructures in the Gulf Coast," by W. F. Herbert, The Texas Company, Houston, Texas, and H. E. Anderson, Texas Creosoting Company, Houston, Texas.

"Modern Developments and Applications in Steam Power," by Geo. B. Kitchell, Humble Oil and Refining Company, Houston, Texas.

"New Developments in Well Completions in Texas Gulf Coast and Southern Louisiana," by I. W. Alcorn, The Pure Oil Company, Houston, Texas; J. U. Teague, Humble Oil and Refining Company, Houston, Texas; and W. A. Alexander, Shell Petroleum Corporation, Iowa, Louisiana.

"Blowouts and the Development of Mechanical Control Equipment," by Madden T. Works, Cameron Iron Works, Houston, Texas.

"Capacity Pumping of Oil Wells," by S. B. Sargent, Sargent Engineering Corporation, Huntington Park, California.

"Flow of Mixtures of Oil and Water Through Sand," by F. B. Plummer, J. C. Hunter, Jr., and E. H. Timmerman, all of the University of Texas, Austin, Texas.

"Causes and Prevention of Blowouts While Drilling," by Chas. B. Carpenter, U. S. Bureau of Mines, Dallas, Texas.

The following Dallas Committee on Arrangements has been appointed: Jno. A. Ritter, chairman, Sun Oil Company, Dallas; H. W. Bass, Bass Drilling Company, Dallas; Z. E. Black, Chamber of Commerce, Dallas; F. I. Brinegar, Continental Supply Company, Dallas; Bruce Clardy, Heyser-Heard & Clardy, Inc., Dallas; Casey Cunningham, Standard Oil Company of Texas, Dallas; C. L. Gladden, Magnolia Petroleum Company, Dallas; N. G. Guiberson, Guiberson Corporation, Dallas; Geo. A. Hays, Jr., Oil Well Supply Company, Dallas; E. N. Koonsman, Pittsburgh-Des Moines Steel Company, Dallas; W. D. McBee, M. J. Delaney, Inc., Dallas; W. H. Meier, The Atlantic Refining Company, Dallas; Elmer Schmidt, Lone Star Gas Company, Dallas; Eric Schroeder, Kibele Manufacturing Company, Dallas; Melbert Schwarz, Seaboard Oil Company, Dallas; K. C. Sclater, *The Petroleum Engineer*, Dallas; E. L. Smith, E. L. Smith Oil Company, Dallas; Paul P. Steed, Lion Oil and Refining Company, Dallas; J. E. Warren, Carl B. King Drilling Company, Dallas.

This committee is arranging an interesting program of informal entertainment for Friday evening, April 2, at 7:00 p. m., consisting of a dinner-dance to be held at "Chez Maurice," atop the Santa Fe Building. A nationally-known orchestra will play for dancing, and a special floor show, including a local choral club, will be presented. A special event will be a humorous review of Southwestern oil personalities.

All hotel reservations should be made direct.

W. R. BOYD, JR.

TWO PROMINENT OFFICIALS WHO WILL ADDRESS THE MEETING

GEO. A. HILL, JR.

International Association for Testing Materials to Meet in London

The International Congress of the International Association for Testing Materials will be held in London, England, April 19 to 24, it has been announced by K. Headlam-Morley, honorary secretary of the congress. A most comprehensive group of papers will be read and a large gathering is expected.

C. L. Reese Returns From Trip

C. L. Reese, sales manager for Globe Oil Tools Company, Los Nietos, California, has just returned to the home office after making an extended sales trip. Points visited included the Rocky Mountain territory where Globe has recently opened an office at Laramie, Wyoming. Considerable time was spent in the Mid-Continent fields.

Geologists to Meet in Moscow

The seventeenth International Geological Congress, which will be held at Moscow in July, will be participated in by hundreds of delegates from many countries. Papers will be read and discussions will be held on the coal and petroleum resources of the world and other phases of mining research. Members also will be given the opportunity to make scientific excursions throughout the U. S. S. R. before and after the convention.

Preceding the Congress, which will assemble in Moscow July 20th, there will be tours both to the south and the north, a visit to the Caucasus Mountain region and a cruise on the Volga.

Following the Congress, a special group will be organized to visit the various oil districts of the U. S. S. R. in the Caucasus. Tours also have been arranged to Magnetogorsk in the Urals, and other large metallurgical and mining centers constructed during the first Five-Year Plan. Special trips to Siberia, to the newly developed regions in the Arctic, and the Donetz basin in the Ukraine have been organized by Intourist, the travel company of the Soviet Union.

Lincoln Moves Cincinnati Office

The Lincoln Electric Company, Cleveland, Ohio, announces a change in address of its Cincinnati, Ohio, office from 5th and Baymiller Streets, to Room 602, American Building, Central Parkway at Walnut Street. This change was made necessary by the recent flood conditions of the Ohio River.

At the new location, F. H. Smith and E. T. Gregory will maintain a complete stock of Lincoln welding accessories and supplies and will be available for consultation on any problem involving the application and use of welding.

Lou Hilton on Trip

Lou D. Hilton, sales manager of Cameron Iron Works, Houston, Texas, is making a trip to the Rocky Mountain fields. From there he will go to California.

Hidden TREASURE Here!

In every pile of discarded valves, pipes, pipe fittings, pumps and parts there is hidden treasure that can be recovered easily and at low cost. One oil company tells us that by using Oakite cleaning materials they helped to salvage over $20,000 worth of parts and equipment. Other companies report equally surprising savings.

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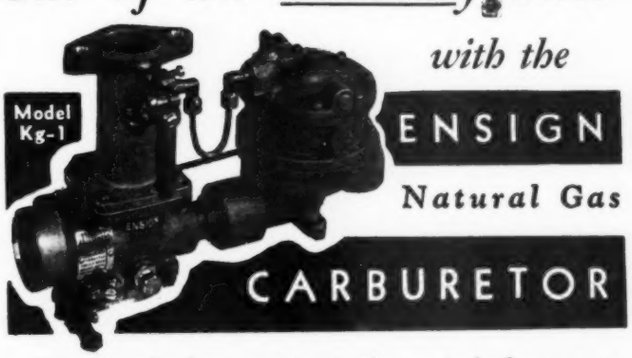

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Principal B-M-W Products are obtainable at supply stores, including: • ADMORE Insert Pump Anchors; • NEILSON Tools (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); • BALLS and SEATS (made for every pumping service); • ADMORE Liner Barrels; • TEX TYPE Plunger Fittings and Valves; and • COLLINS Belt Clamps.

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OIL WELL SUPPLIES
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TRADE LITERATURE

IN A NEW BULLETIN, 3600-A1, Fairbanks, Morse and Company describes the construction and applications of its Model 36 Diesel Power Units. The Model 36 Diesel offered in 2-cylinder sizes and in various combinations, with rating as low as ten hp., is the smallest in the complete line of Fairbanks-Morse Diesels.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has issued Bulletin No. 318, descriptive of its Type S-6005, 200-amp. welder. Bulletin No. 320 also has been issued, describing Type S-6018, 400-amp. welder. Either or both of these bulletins will be sent free upon request.

BLACK, SIVALLS AND BRYSON, INC., Oklahoma City, Oklahoma, have issued a new bulletin on their wood tanks, copies of which are being sent upon request.

A NEW LEAFLET issued by the General Electric Company, Schenectady, New York, describes the company's automatic switchgear, pointing out the advantages of its use. Copies may be obtained free from the manufacturer.

THE BROWN INSTRUMENT COMPANY, Philadelphia, Pennsylvania, has published a new catalog on Brown flow meters. This new Catalog (No. 2004) covers the complete line of Brown flow meters—indicating, recording, and integrating—in both electrical and mechanical types, together with Brown Air-o-Line flow and liquid level controllers.

A NEW BOOKLET, No. DH-984, covering Page Hi-Tensile F Electrodes, has just been issued. This booklet describes this shielded arc electrode in detail and the shielded arc method of welding, with illustrations showing the procedure for various types of welds. The Page Hi-Tensile F Electrode is a general purpose electrode of the shielded arc type suitable for all welding positions. A copy of this booklet will be sent by the Page Steel and Wire Division of American Chain and Cable Company, Inc., Monessen, Pennsylvania, on request.

PIPE LINE BRIDGES are described in a new bulletin (No. 303), recently issued by the Pittsburgh Des Moines Steel Company of Pittsburgh, Pennsylvania. Profusely illustrated, this booklet gives several instances of pipe line bridges in service. Copies are available by addressing the manufacturer at 3419 Neville Island, Pittsburgh, Pennsylvania.

THE C. J. TAGLIABUE MANUFACTURING COMPANY of Park and Nostrand Avenue, Brooklyn, New York, announce the publication of a new TAG Laboratory Thermometer and Hydrometer catalog, No. 1100A. In addition to the regular line of extreme precision and standard grade TAG Thermometers and Hydrometers, this new catalog now includes complete listings of the widely used A.S.T.M. Thermometers with illustrations, also the well known TAG-A.P.I. and TAG Certified hydrometers. A catalog will be sent free by the manufacturer on request.

IN ORDER TO INSURE the most efficient application of industrial packings to the specific purposes for which they were designed, United States Rubber Products, Inc., has issued a 112-page manual on the subject. This comprehensive manual

is to assist engineers in properly adapting the various "U. S." packings to their specific needs. It gives complete engineering data indicating the various characteristics of each packing. Several special sections are devoted to recommendation charts. A special 12-page engineering section is devoted exclusively to charts listing specific gravities, the temperature of steam at different pressures, fahrenheit-centigrade conversion table, metric conversion table, melting points of materials and their weights, and other useful data.

* * *

THE VICTAULIC COMPANY OF AMERICA, 26 Broadway, New York City, has published a new and exceptionally complete catalog (No. 37-4) on Victualic pipe couplings and fittings as used with steel, wrought-iron, and cast-iron pipe. The catalog combines relevant engineering data and illustrations of many field installations.

* * *

A BOOKLET liberally illustrated and detailing the best practices for the care and handling of sucker rods in the field has been published by The S. M. Jones Company. This booklet is the result of numerous requests from producers for a series of good practices that should be followed in the field to insure the most economical results. The practices suggested are the result of a collection of information by the Jones field engineering department and are based on the procedure now being followed by many producers. The first edition incorporates an unusual idea, as a postcard is included with each booklet upon which the reader is asked to add his suggestions for improvement of the practices outlined so that future editions may be improved. Copies may be obtained by writing The S. M. Jones Company, 518 McBirney Building, Tulsa, Oklahoma.

* * *

THE MARTIN-DECKER CORPORATION, Long Beach, California, has issued a folder on its new Clipper model weight indicator. This new instrument is the latest advancement in weight indicator design and is made to meet the ever-increasing demands of modern drilling for accuracy, strength, sensitivity, and flexibility, the manufacturers state. Copies of the folder are available from the manufacturer.

Van Bennett Heads Mid-Continent Production District A.P.I. for 1937

VAN D. BENNETT

Van D. Bennett, of British American Oil Producing Company, Tulsa, Oklahoma, has been elected 1937 chairman of the Mid-Continent District of the American Petroleum Institute's Division of Production. The election was held in connection with the district's spring meeting at Tulsa.

Oscar Hatcher, independent operator of Ada, Oklahoma; C. E. Sturdevant, of Phillips Petroleum Company, Pampa, Texas; and N. M. Hutchinson, of Empire Oil and Refining Company, Oil Hill, Kansas, were elected 1937 vice chairmen. Henry Keplinger, of Shell Petroleum Corporation, Tulsa, was elected secretary and treasurer.

The Ralph M. Parsons Company has just moved into permanent quarters at 310 South Michigan Boulevard, Chicago, Illinois. The organization has been occupying temporary offices on a lower floor of the same building.

Arthur Zoll, Tower Petroleum Building, Dallas, is the Mid-Continent representative of the Parsons organization.

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YOUR *Cavins* REPRESENTATIVE

The CAVINS — 3 TOOLS IN ONE

Your Cavins Service Man is a specialist at clean-out and fishing jobs... and his partner — The Cavins—is a specialized tool for such jobs. This crack team is at your service every hour of the twenty-four... and when you run into trouble the way to lick it in a hurry is to 'phone the nearest Cavins agency.

From extensive past experience your Cavins Service Man knows the right Cavins, the right accessories, and the right technique for your particular bailing or fishing problem. Following his expert instructions, your crew gets the job done with big savings in time, labor, money, and production.

Get set for these advantages on your next clean-out or fishing job by noting the nearest Cavins agency in the list below.

THE CAVINS COMPANY

2853-73 Cherry Ave. Long Beach, Calif.
Phones 414-14; 414-60
Cable Address: "Cavins, Long Beach"
Foreign Representative: R. J. Eiche

Bakersfield, California — Kilgore, Texas
Taft, California — Pampa, Texas
Ventura, California — Oklahoma City, Okla.
Odessa, Texas — Wichita, Kansas
Houston, Texas — Lyons, Kansas
Lake Charles, Louisiana

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